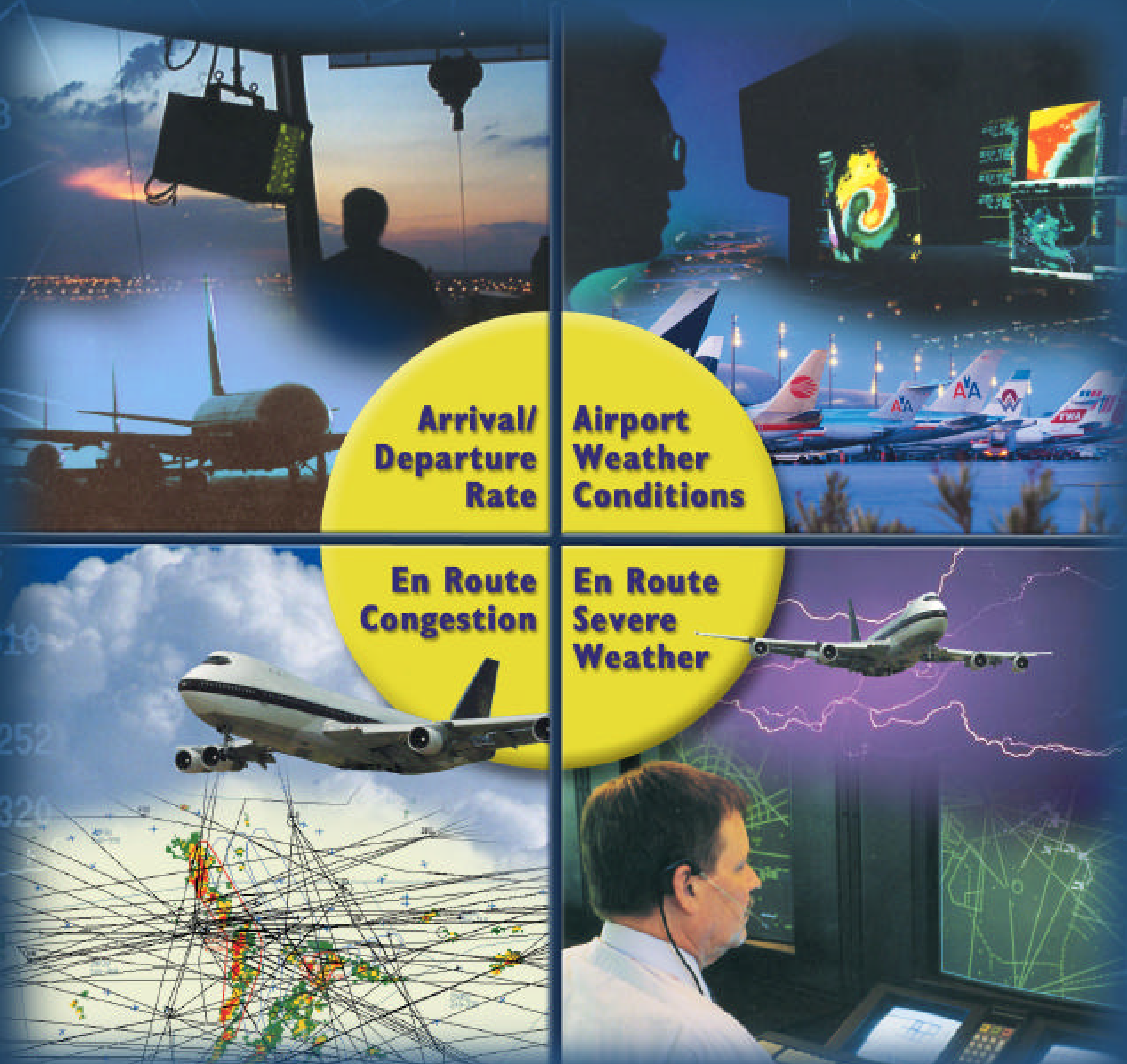



# NATIONAL AIRSPACE SYSTEM
# OPERATIONAL EVOLUTION PLAN

## A Foundation for Capacity Enhancement 2003–2013

EXECUTIVE SUMMARY

December 2002
Version 5.0

U.S. Department
of Transportation
**Federal Aviation
Administration**

Office of the Administrator

800 Independence Ave., S.W.
Washington, D.C.  20591

December 2002

Dear Members of the Aviation Community:

I am delighted to present the Federal Aviation Administration's (FAA's) Operational Evolution Plan (OEP), Version 5.0. The OEP continues to represent FAA's commitments for improving capacity and efficiency in the National Airspace System over the next ten years. These commitments have been generated in consultation with the leadership of the aviation community and in partnership with the Department of Defense and the National Aeronautics and Space Administration.

As you can see in this Executive Summary, these joint efforts are moving forward and we are making progress clarifying user needs and putting in place new technologies and new procedures to address those needs. We are already realizing the benefits of increased system capacity and efficiency as a result.

This past year has been a difficult one for our nation and for the aviation community. The flying public has had to adapt to new security activities. The aviation community has had to adapt to a tightening economic climate. When the volume of air traffic comes back, and it will, we will be ready with an advanced and flexible system that provides more choices to airlines, industry and the flying public.

This version of the OEP balances program progress with a crisper vision that emphasizes collaborative decision making, required navigation performance and shared information systems. This is particularly fitting as we approach the fifth anniversary of the National Civil Aviation Review Commission, created by the United States Congress. As a result of the commission's recommendations, it is apparent through the OEP how the FAA sets priorities and achieves performance outcomes, while accelerating user benefits and assuring that resources are sufficient and used effectively. I invite you to read more details at the OEP web site: www.faa.gov/programs/oep.

Thank you for your continued support, active participation and dedication to aviation.

Marion Blakey

Marion C. Blakey
Administrator

# SNAPSHOT OF VERSION 5.0

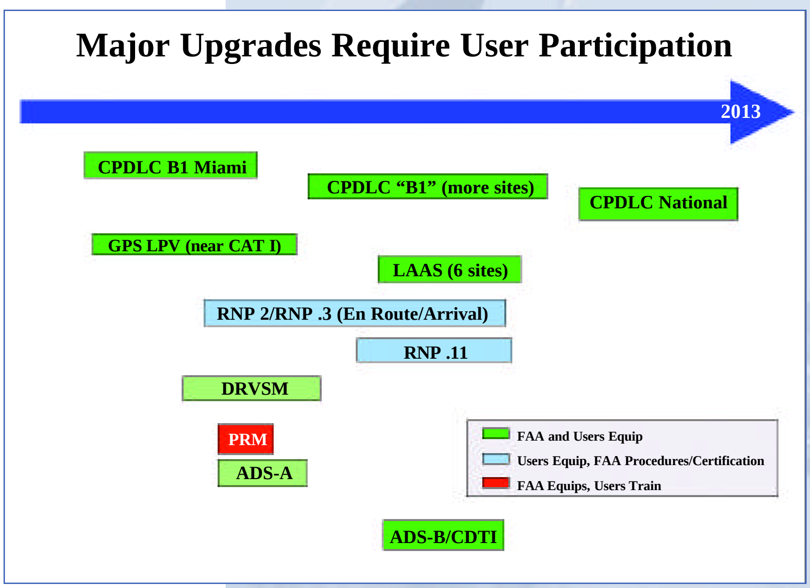
## Introduction

The Operational Evolution Plan (OEP) is the Federal Aviation Administration's (FAA's) rolling ten-year plan to increase the capacity and efficiency of the National Airspace System (NAS) while enhancing safety and security. The commitments and decisions in the OEP have emerged from a close collaboration with the entire aviation community, including the airlines, cargo carriers, airports, manufacturers, general aviation, the Department of Defense (DOD), the National Weather Service, and the National Aeronautics and Space Administration, all with a focus on the air transportation services delivered to the flying public.

The OEP represents the agreements and commitments of the FAA, DOD and the aviation community to modernize the NAS and solve problems in core areas, or quadrants: Arrival/Departure Rates, En Route Congestion, Airport Weather Conditions, and En Route Severe Weather.

The tragic events of September 11, along with a depressed U.S. economy have significantly impacted the airline industry. Overall, the number of airport operations during 2002 was about 10 percent below 2000 levels, and the number of en route operations during 2002 was about five percent lower than 2000 levels. While traffic has recovered more rapidly at Midwest airports than on the East and West coasts, airports that consistently demanded attention in the past continue to do so and as the economy improves, we fully expect that the demand for aviation services will increase to pre-September 11 levels. In fact, one aspect of the demand for aviation is already affecting operations; namely, airlines are continuing to increase usage of smaller aircraft, including regional jets, adding to already complex traffic flow management in many areas across the nation.

For these reasons, we are staying the course to build an aviation system for the 21st century with efficiency and capacity improvements needed to meet the growing demand for air travel and cargo shipment. At the same time, we have taken into account the current economic climate by providing increased clarity about avionics requirements that build on existing equipage. Version 5.0 of the OEP captures commitments and investments across the aviation community and presents key accomplishments, activities and policy decisions that the community has reviewed and advocated through a process established by RTCA, the standards-setting association for the aviation community.



# REPORT CARD OF THE OEP

## State of the Evolution

To date, the aviation community has realized the following operational improvements set forth in the OEP:

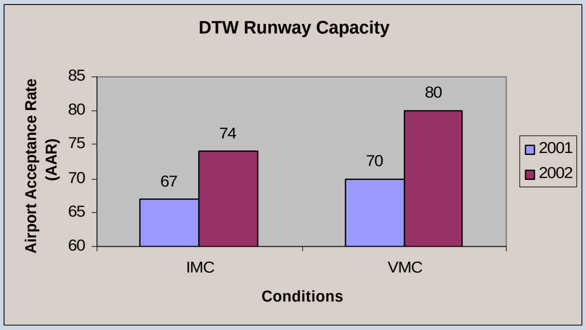
- ***Increased arrival and departure rates***
  - New runways have been constructed at the Phoenix and Detroit airports
  - All choke point actions are complete
  - The Traffic Management Advisor (TMA) is operational at seven sites
  - New and overlay area navigation (RNAV) routes have been implemented
  - The Administrator's Policy on Required Navigation Performance (RNP) has been implemented
  - Las Vegas implemented the four corner post airspace redesign
- ***Decreased en route congestion***
  - All choke point actions are complete
  - The User Request Evaluation Tool (URET) is now operational in six centers
  - The Controller Pilot Data Link Communications (CPDLC) Build 1 tool is in use at Miami Center
  - There are more web-based collaborative tools and better quality data for managing congestion
  - Gulf of Mexico RNAV routes have been implemented
- ***Improved flight during unfavorable airport weather conditions***
  - Installed Precision Runway Monitor (PRM) at Minneapolis-St. Paul and Philadelphia airports, and operationally validated benefits
  - The first production unit of the Integrated Terminal Weather System (ITWS) is in use at Atlanta
  - Runway Visual Range data is now provided to users via Collaborative Decision Making Network (CDMNet) and available to more than 49 airports
  - Precision approaches Instrument Landing System (ILS) has been implemented at 14 airports
- ***Improved flight during severe en route weather conditions***
  - Ground delay programs are being executed with improved compliance
  - The Collaborative Convective Forecast Product (CCFP) extended range forecast of thunderstorms is available on the Command Center Website
  - The Playbook has been expanded to 114 plans to provide more options
  - Weather radar data is now available on en route controller's display
  - The Flow Evaluation Areas (FEA)/Flow Constrained Areas (FCA) Collaborative Routing Coordination Tools (CRCT) prototype functions have been implemented on the Enhanced Traffic Management System (ETMS).
  - Implemented Virginia Capes (VACAPES) agreement on use of east coast warning area airspace for hazardous weather avoidance

Each of these initiatives increased the capacity and efficiency of the NAS, and has provided direct benefit to NAS users. Many of these represent the initial installment of a longer-term plan or water fall.

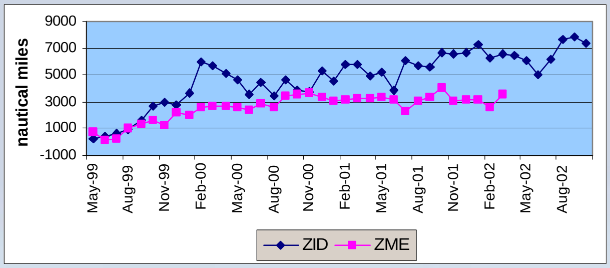
## Overview of 2002 Performance Results

Overall, capacity at the OEP airports has increased over 2% since OEP inception. Although decreased demand levels did influence overall peak throughput in 2002, the peak visual throughput index at 15 of the 34 airports studied (or nearly 45%) were higher than in 2000. Compared to the OEP baseline year 2000, delays have fallen by approximately 30%, while traffic volume changes have varied throughout the NAS, ranging from 5% at the en route centers to approximately 15% at the pacing airports.

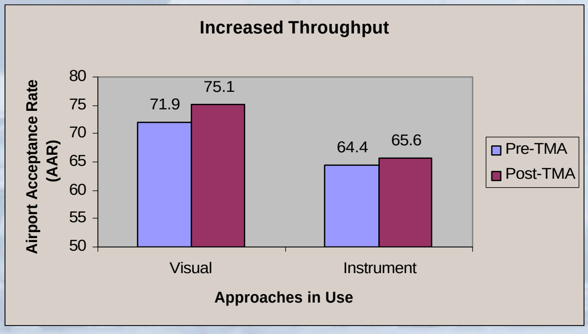
- The Detroit runway became operational December 11, 2001. By Spring 2002, the Airport Capacity Visual Meteorological Conditions (VMC) index (representing the available capacity) was up 16%, and Airport Throughput VMC index (representing what was serviced on average during the peak of arrivals and departures) was up about nine percent.
- Forty RNAV routes have been completed.
- Las Vegas implemented the Four Corner Post Airspace Redesign in December 2001. Las Vegas became the first major airport to use RNAV arrival and departure procedures for all runways. Preliminary results confirmed predictions of significant user savings.
- All choke point actions were implemented. By August 2001, with over 70% of the action items completed, an interim analysis showed performance improvement in five of the seven choke points, equating to approximately $38M in cost savings to aviation system users. Traffic reduction after the September 11, 2001 terrorist attacks has made it difficult to show the system impacts of the completed action items. However, in Great Lakes en route airspace where traffic has rebounded to pre-September 11 levels, the actions resulted in impressive reductions in delay (15%-40%, depending on the choke point).
- URET has allowed restriction removals and lateral amendments have saved approximately 7000 nautical miles (nmi)/day at Indianapolis and 3500 nmi/day at Memphis.
- Chokepoint actions, CDM and URET together allowed the maximum hourly occupancy in the Midwest centers (Cleveland, Indianapolis and Chicago) to reach 102.5% of the 2001 levels.
- The TMA is in use at seven centers supporting arrival metering and merging. Three sites (Dallas, Minneapolis, and Los Angeles) experienced a five percent increase in throughput, and Denver experienced a two percent gain.
- PRM in Minneapolis provided an increase in arrival rates of six percent or better, which equates to four more flights per hour, while in operation. Operations have since been suspended, however the FAA is working to reestablish operations.



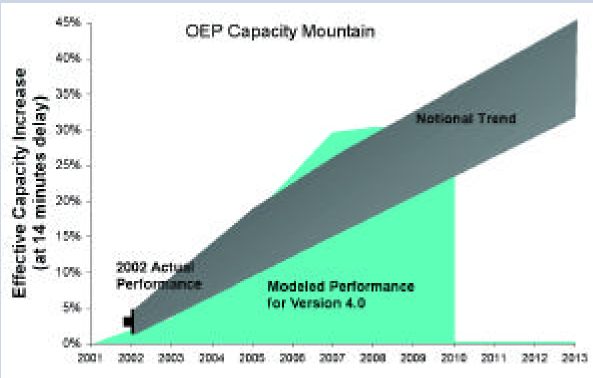

*Detroit Runway Capacity Gains*




*URET Distance Saved for Lateral Amendments Daily Average*




*Increased Throughput from TMA at Minneapolis*




***Modeled capacity gains for Version 4.0 and anticipated trends from Version 5.0***

## Capacity Expectations

The OEP Capacity Growth Chart projects the cumulative modeled capacity gains from OEP commitments. We are moving in a positive direction and have met our projections for 2002. The near term projections reflect significant capacity growth as a result of Reduced Vertical Separation Minima (RVSM), airspace redesign, and several new runways that will be put into service over the next two years. We also will continue to add more URET and ITWS sites, and a number of other capacity enhancements.

Capacity projections for the out-years will increase since two runways and four TMA sites were added as part of Version 5.0. Also impacting projected growth will be a number of programs that are planned, including 10 more proposed runway projects at benchmark airports, a focused effort to promote various airport initiatives (improvements to airports such as runway and taxiway enhancements), RNP, and significant enhancements to the current Collaborative Decision Making (CDM) philosophy. On the negative side, the expected gains will be diminished by the Charlotte runway that was dropped due to the local situation. In addition, some of the projected gains will slide to the right as two runways were delayed (ATL and SEA), also due to local situations. Furthermore, CPDLC has been delayed due to various difficulties. During 2003, the capacity mountain will be recalculated once the airport benchmarks and the terminal area forecasts are updated.

This year, we closed two solution sets: Reduce Offshore Separation and Provide Access to Special Use Airspace (SUA). Reduce Offshore Separation is closed because the technology solution could not be achieved and no viable alternatives are currently available; other activities involving the Gulf, such as RVSM and RNAV routes, are in other solution sets. The SUA solution set is closed because the milestones were successfully completed. Some initiatives involving “access” are in other solution sets, while others are part of ongoing activities not related to OEP. Neither of these solution sets contributed to the capacity mountain assumptions. In addition, new smart sheets have been added for airport weather to capture wake mitigation and along track separation procedures.

## 2002 Experiences from the Evolution

During good economic times, real change happens slowly with significant preplanning and coordination. Under the current circumstances, uncertainty in timing and in some cases even the viability of the industry partners make coordination and commitment more complicated. Despite the FAA's best efforts to achieve and retain a Government and industry commitment for the OEP implementation, the outlook for significant, partnered investment is dimmed by growing security costs and airline industry restructuring. With version 5, many plans for new runways, equipage of aircraft, and participation in new procedures are under review. Examining which 2002 accomplishments went smoothly, and discovering what created the difficulties in others, should improve the community's ability to manage the OEP implementation in spite of these uncertainties.

Ground based capabilities and joint activities that were in development for several years (e.g., CPDLC trials), generally had minor disconnects that were resolved in the routine course of implementation. In some cases, technology failed to deliver the operational change in a cost effective way, e.g., Gulf of Mexico communications, so new strategies were adapted. The greatest difficulties came from changes affecting both flight planning and pilots and controller training, e.g., PRM and LAS redesign. The implications of the transition of LAS to an all RNAV airport was not well understood, and the resulting mixed operational practices created chaos. Much was gained from this experience which validated the significant benefits that would follow these changes. With the successful conclusion of the System Choke Points Program, the FAA has embarked on an initiative with the RTCA's Free Flight Select Committee's Airspace Working Group to engage aviation users and stakeholders on a regular basis, producing a consensus view of airspace priorities and aligning resources with those priorities.

Where equipage had been preplanned, the community has re-entered the planning stage. Plans for cockpit display procedures and CPDLC moved forward in 2002, but it became clear that any solid plans are still a few years away.

Axiomatic to the OEP is the concept that benefits are realized by users who equip with new technology and change their operations to reflect new ATC techniques. Over the past 18 months, it is clear that demand and therefore equipage is highly elastic. In out-year research efforts, the FAA committed to significant user equipage costs. This strategy, used in the Safe Flight 21 project, enabled concept validation and benefit determination. In contrast, Controller Pilot Data Link Communications that relies on airlines to bear the cost of equipage is unable to move forward with national implementation until a critical mass of aircraft equip and controller workload is reduced. Furthermore, the challenge is circular: a benefit must exist to support industry investment but the benefit depends on user equipage.

Another complex, circular issue surrounds the certification of ground-based and avionics systems. In the past, certification dealt principally with aircraft equipment. The OEP requires a closer interoperability of ground and air-based systems. This in turn drives the need for a true systems-level engineering analysis and allocation of safety validation across these systems and therefore, government and industry boundaries. As a community we have begun this process within RTCA's Concept of Equipage and OEP Working Group efforts. However, to detail a true evolutionary implementation, we must derive a compelling cost benefit across the community with frequent re-evaluation as we encounter the inherent challenges of complex systems development.

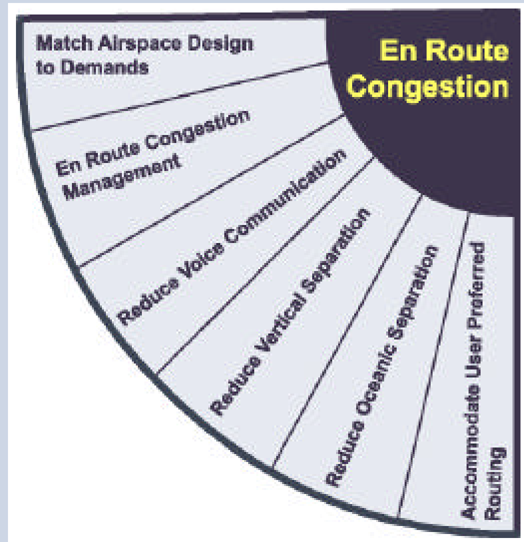
## Community Challenges

The OEP was established to coordinate community efforts to expand the capacity and improve the efficiency of the NAS. Routine discovery of community challenges is a natural part of this endeavor. In most cases, identified challenges are resolved so the community can adhere to the original plan. In other cases, the challenge will require a change in strategy with the focus remaining on the original objective. For example, this year's efforts to complete voice communications in the Gulf of Mexico would have enabled domestic non-radar procedures for that airspace. When technological failures precluded this plan, we looked to other procedures to support the original goal of achieving greater capacity in the Gulf of Mexico.

A wide range of challenges face the community implementation efforts in the coming year. Prepared with the lessons learned from the 2002 experiences, the FAA will work with the community for a successful OEP implementation. The most significant challenges are listed below. These complex issues will require leadership and greater industry stability than exists today. In some cases leadership will be governmental and in others industry is better suited for the role.  Working with RTCA, the FAA remains optimistic that these issues will be resolved in the best interests of the flying public and the nation's economy.

- **RNP Standards and Flyability:** In 2003, the FAA will publish criteria for RNP-2 and RNP-0.3. This step is only the beginning of the effort to develop flyable routes for cruise, arrival and departure. From the experience gained in developing RNAV routes, the community now understands the coordination of vendor and user data, plans for training, and other issues involved to avoid the need for rework of airspace designs and procedures.
- **Reestablishing PRM Operations:** PRM Operations were suspended in Minneapolis following a reevaluation of safety implications in a mixed environment of participants and non-participants; however, the operational application was successful.  The FAA is coordinating a proposal to resume operations with users.
- **New Runway Surveillance:** New runways are being built at less than standard spacing. Funding and surveillance needs to support parallel operations at these airports are unresolved.
- **Crossing Procedures:** Procedures to address crossing runways require joint FAA industry acceptance.
- **Unified Surface Approach:** Several airports and users have programs underway to improve surface coordination. At the same time the FAA is trying to establish a national approach for traffic management use.
- **CPDLC National Deployment:** Economics will slow the pace of equipage. The FAA has cost issues with certification.
- **Integrated Community Schedule:** Some joint deadlines were missed due to unilateral priority changes without informing others.

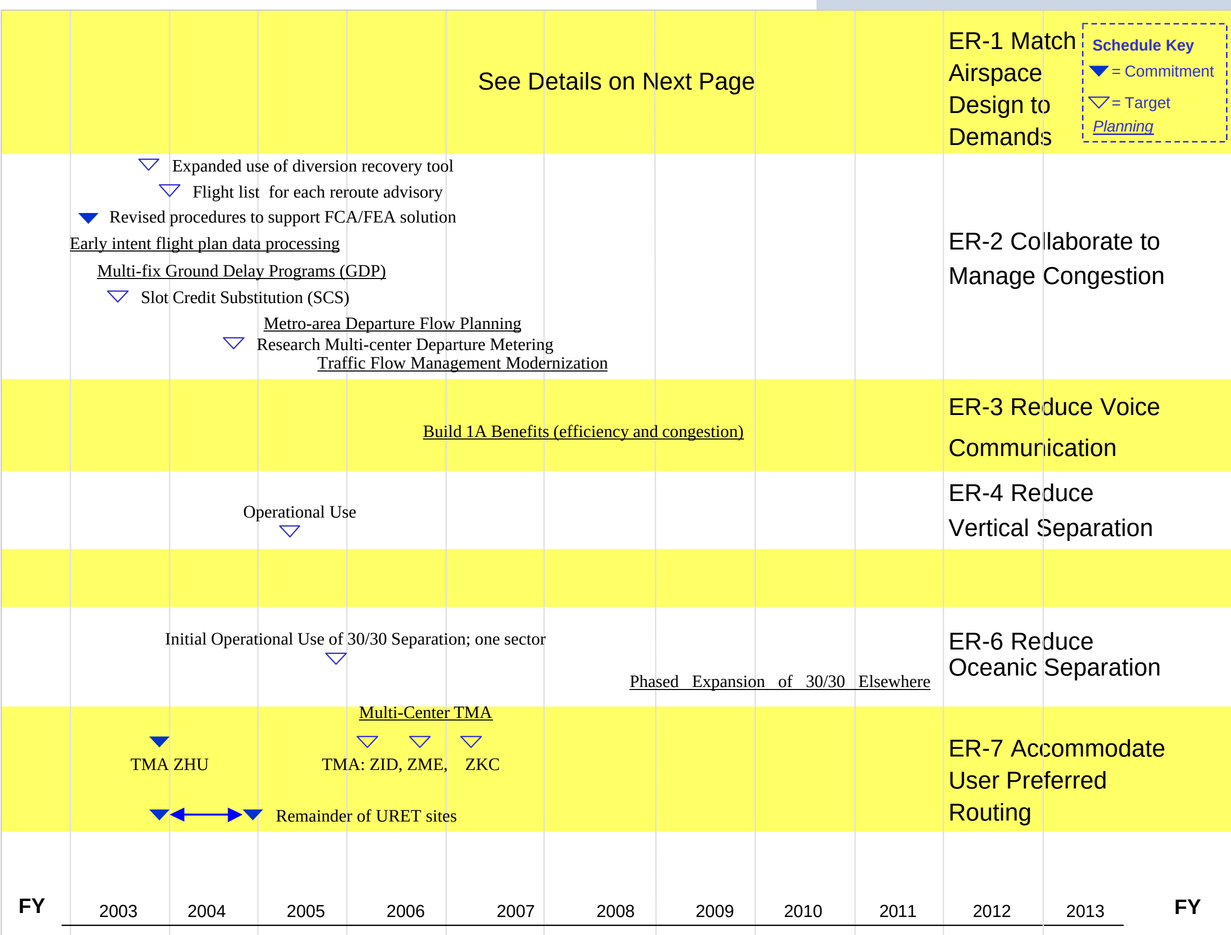
# OVERVIEW OF VERSION 5.0



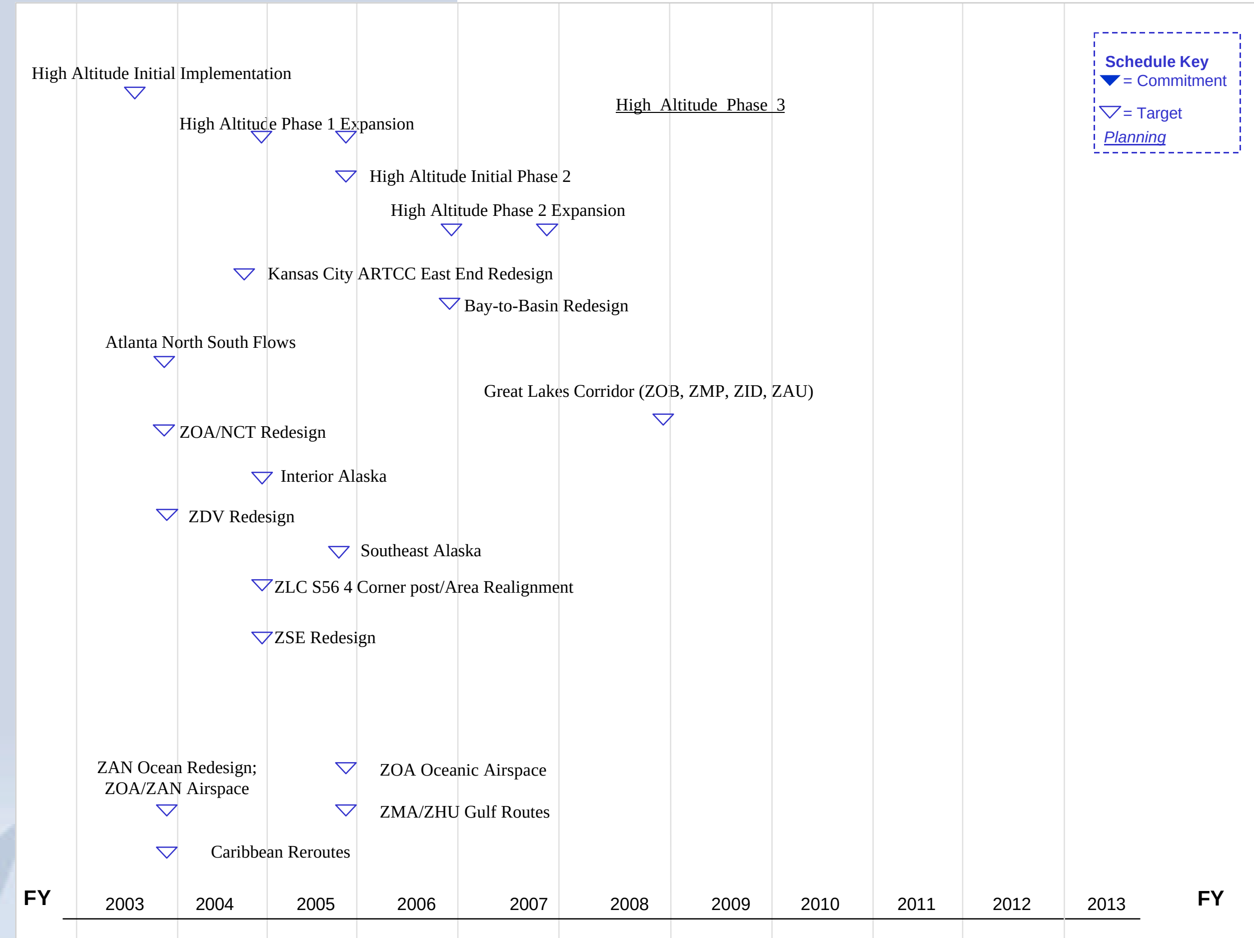

## En Route Congestion

In the en route arena, capacity and efficiency are governed by airspace design, flow planning practices, separation standards and controller workload. Airspace design changes are being made both in the short and long term to fit sectors to the traffic demand and to establish more effective airspace structures in the long run. The long term plans include routes based in RNP of the aircraft. The transition to collaborative decision making and "system thinking" will change flow planning practices to better match available capacity to the demand. Domestic Reduced Vertical Separation Minima (DRVSM) will reduce vertical separation standards from flight level 290 to flight level 410 within the NAS including Alaska and the Gulf of Mexico. Horizontal separation standards of 30 miles are planned in the Oceanic airspace. Controller pilot data link communications along with tools for accommodating and managing user plans and requests (URET and TMA) will assist controllers in managing the forecasted increase in demand.

## En Route Congestion Quadrant Timeline

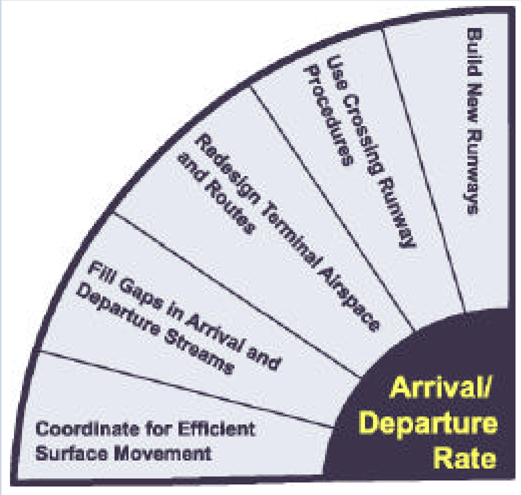


# ER-1 Match Airspace Design to Demands

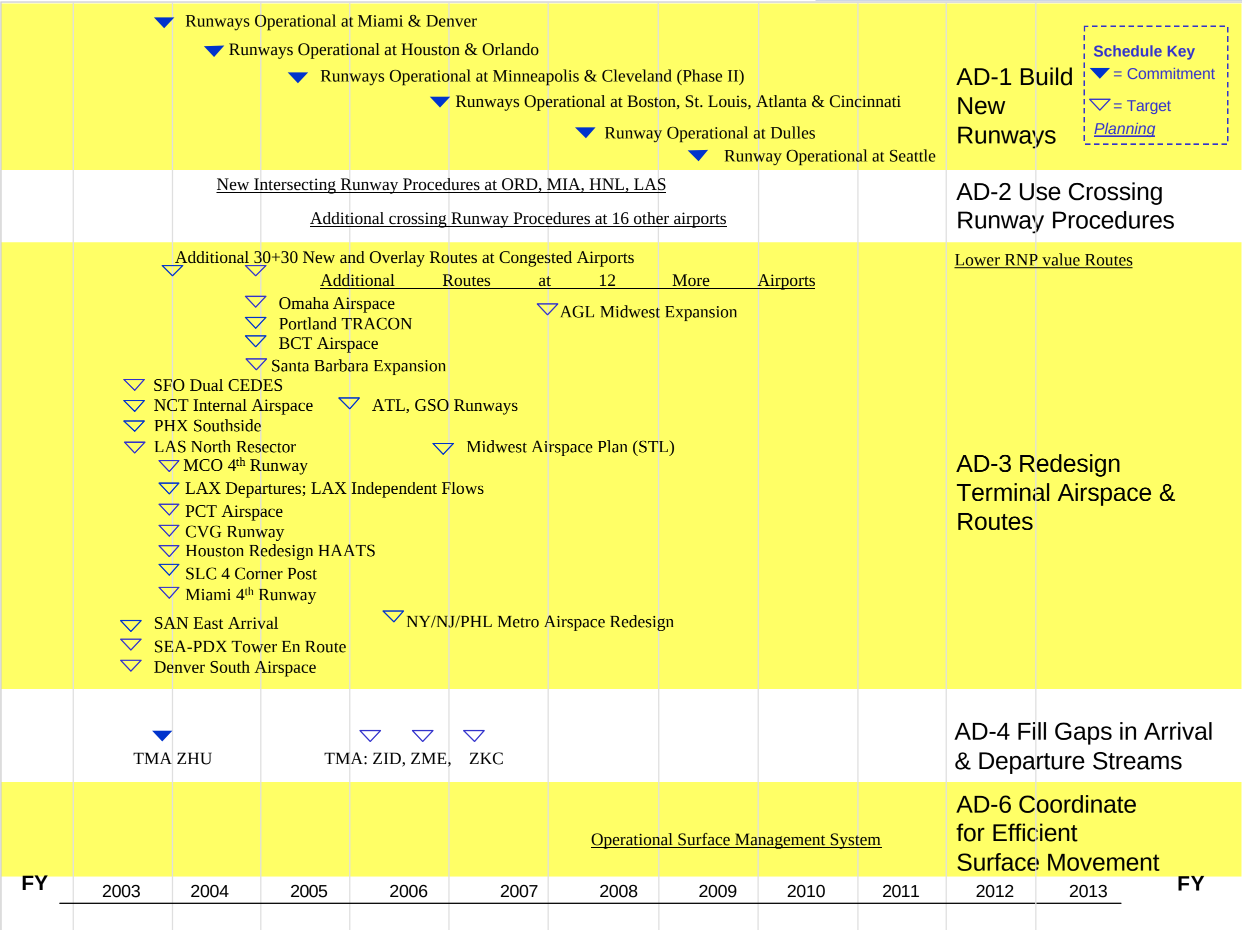


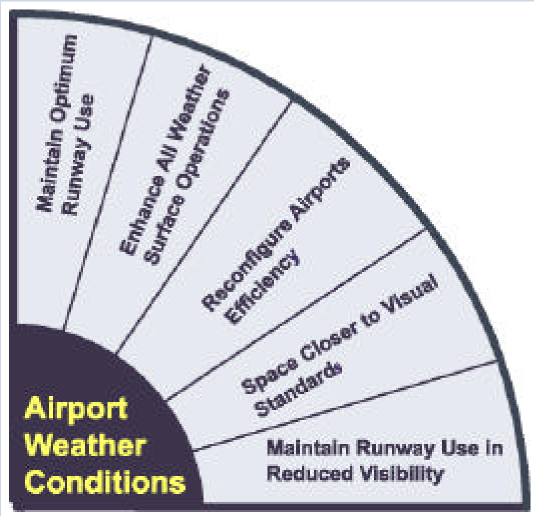
## Arrival/Departure Rates

There are two main strategies to help airports meet peak demand: build new runways and maximize the use of existing runways. New runways can increase the capacity and efficiency of an airport, but may take 10 years to plan, construct and commission. Currently, the OEP includes 12 runways planned at benchmark airports. A combination of air traffic procedures, new technologies, improved airspace design, surface management, and decision support tools are proposed to make better use of existing runways. Procedures will be evaluated for crossing runway configurations at 18 benchmark airports. Terminal airspace redesigns, planned for most of the benchmark airports and metro areas are aimed at improving the transition of arrivals and departures. Traffic management advisory tools which help in managing the arrival stream will become operational at an additional four sites. Also the multi-center capability will be evaluated in the Philadelphia area. Surface management systems are being explored for operational use later in this decade.




## Arrival/Departure Rates Quadrant Timeline

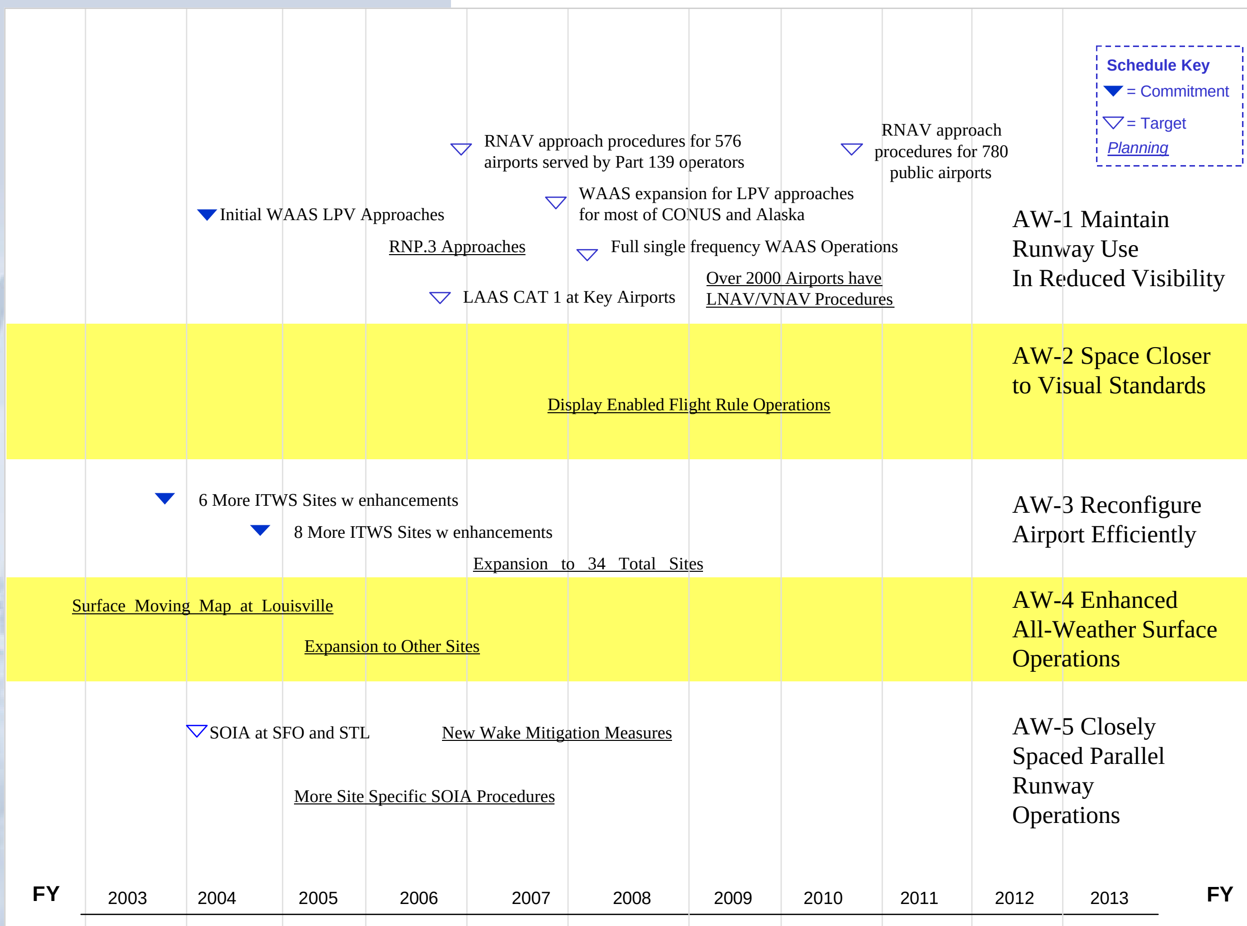




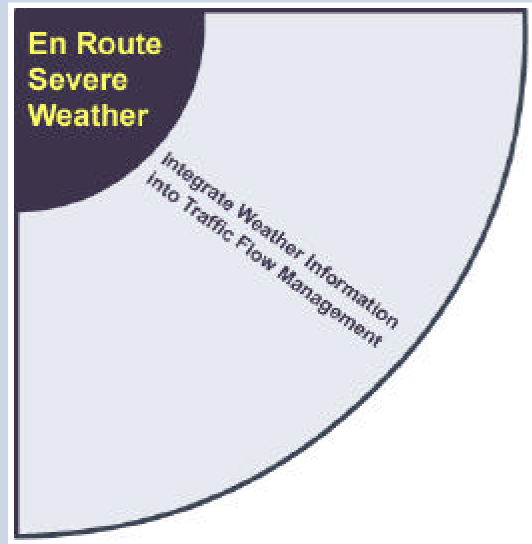

## Airport Weather

For the benchmark airports, inclement weather operations lower arrival and departure rates an average of 18 percent. As weather or visibility degrades, runway use may become limited and spacing between aircraft is increased. To make airport operations less sensitive to weather, we need more options for runway configurations and more consistent spacing of operations, much of which requires new technologies. With RNP and improved navigation means, precision approaches become available at more airports. A variety of procedures including wake-mitigation, offsets and along track separation, and flight monitoring allow operations to increase on closely spaced parallel runways as bad weather moves in. Cockpit Display of Traffic Information may enable visual approaches to continue into marginal visual flight rules conditions. A moving map display may also help with improved surface situational awareness.

## Airport Weather Quadrant Timeline

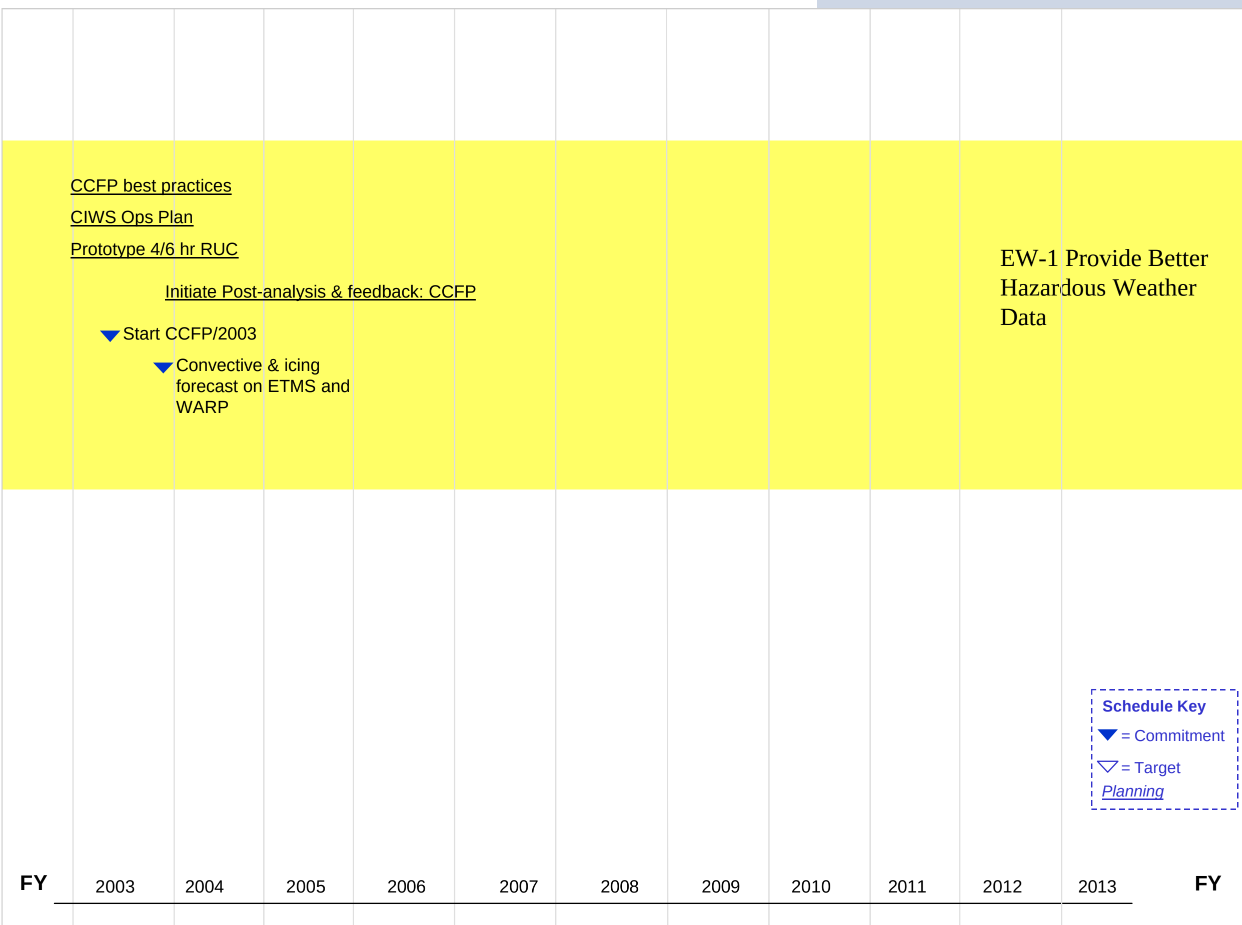


## En Route Severe Weather




In fiscal year 2002, over 70 percent of delays were attributed to restrictions due to weather. These results are typical of recent years. Improving forecasts, sharing real-time data and the application of weather information to traffic management planning, as well as integrating weather information into decision support systems will mitigate weather related delays. The disruptions caused by hazardous en route weather are magnified by the uncertainty in the location, movement and severity of the weather conditions. Forecast accuracy is not well suited to the strategic planning of traffic flow decisions. Joint planning is further hindered by limitations in real-time data sharing capabilities. Operational decision making by airlines and traffic flow managers will be improved when common awareness of the situation and a methodology to mitigate the impact are coupled with the improved data exchange, training for interpretation of forecasts, and the coordination processes.

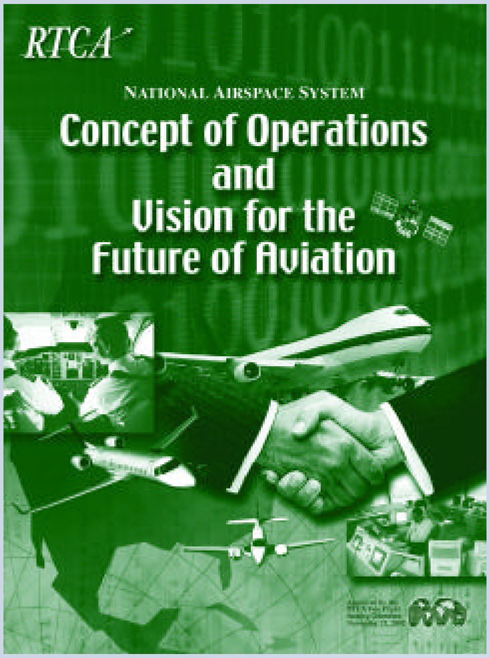
## En Route Severe Weather Quadrant Timeline



# VISION

## Guiding Vision for the OEP

In the future, the NAS will become a technology-intensive, but human-centric information system that supports reliable real-time decision making. As the vision evolves, the OEP will detail the tactical, community consensus commitments that will implement the system.  Currently, the conceptual foundation for this vision is contained in the Future Concept of Operations, a government-industry strategic look at the NAS published by RTCA.




***RTCA's concept of operations is the OEP foundation.***

Technological advances and procedural improvements, driven by use of satellite navigation tools and procedures like RNP, will permit flexible airspace designs, more routing options, an increase in the number of flights that can safely operate in a given airspace and an increase in access to airspace. This allows a shift from standard operations tied to the performance of ground-based systems to operations tailored for aircraft system performance.

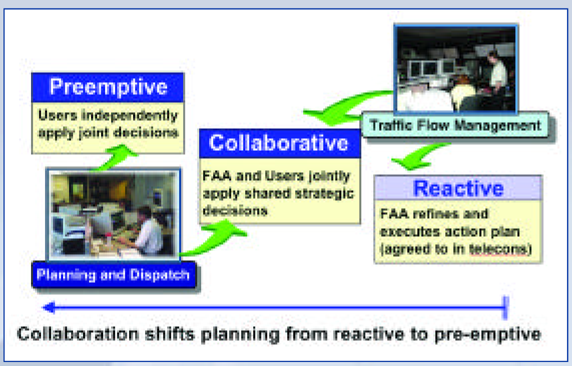
Airports will have new capabilities as well. Along with new runways at some of the busiest locations, more airports will be equipped to operate in a wider range of weather conditions and increase use of parallel runway operations, reducing the need for flight restrictions. All this will occur with the introduction of new and expanded operations: differences in airports, demographics, changes in fleet mix including new types of aircraft (e.g., unmanned vehicles); and wider use of general aviation, regional, and business aircraft.

Shared and secure information is the hallmark of the future. New technologies now in testing, others in the research stage, and some not yet imagined will enable more precise information in the air and on the ground. Increased use of satellite technology and digital data links, along with improvements in automation, will increase reliability and flexibility throughout the airspace system. This enhanced information and communications environment will not only improve efficiency, but support national defense requirements as well. Pilots, controllers and others will see the same information by way of integrated networks, leading to more complete and real-time sharing of situational awareness. As we increase the variety and utility of information available to pilots and controllers, passengers will benefit as well. The public will have access to much of the same information that the FAA and the airlines have on weather, air traffic, and airport conditions throughout the aviation system.

Shared information will improve daily collaborative decision-making between the FAA and airspace system users such as the airlines, general aviation, and military. Collaborative decision making has already eliminated thousands of hours of delays, improving efficiency and effectiveness. State-of-the-art decision support tools will systematically implement the rules of collaborative decision making and improve efficiency in all phases of flight.

In accomplishing all this, we will continue to strive for international consistency of procedures and systems to achieve what is called global harmonization.

The OEP is consistent with recent FAA acquisitions and policies, including: the Standard Terminal Automation Replacement System, En Route Systems Modernization programs, Advanced Technologies and Oceanic Procedures, and RNP criteria. These systems and procedures speed the introduction of new decision-support applications, improve the reliability of the operating systems, and allow the FAA and the user community to take full advantage of modern avionics.  The OEP together with the infrastructure and safety NAS modernization efforts will conform to the priorities and support the national security mission.


*Expanding opportunities for collaborative decision making*

## Looking Forward to Version 6.0

OEP Version 5.0 reflects the first complete post-September 11, 2001 look at the NAS and the adjustments made to the OEP. Though current economic conditions caused us to delay some initiatives, the OEP continues to reflect the maturing of procedures and new technologies. Specific implementation delays stem from financial difficulties and center around local uncertainty in a small number of airport runway programs, along with uncertainty about the timing of the airlines ability to equip their fleet to support OEP initiatives. However, we expect that air traffic, measured in terms of operations, will return to its pre-September 11th growth pattern between 2005 and 2007. As a result, we cannot deviate from our commitment to modernize the NAS and increase its capacity and efficiency.

With Version 6.0, the OEP will continue to respond to the changing operating environment and the financial condition of system users, as well as FAA funding uncertainties. This may ultimately require additional prioritization of activities.

As always, safety is of primary importance, and, in OEP Version 6.0, we will clearly describe the links between the OEP and the FAA's program for ensuring safety in the NAS. We will also describe the infrastructure initiatives needed to realize the OEP, and provide a clear path that ensures the timely availability of infrastructure components.

The FAA will continue to improve its efforts to integrate lines of business and decision making, and to become more performance driven. Schedules and data bases have been integrated to better manage resource contention generated by multiple commitments. A metrics plan has been added to Version 5.0 that details the measures that will be used to evaluate and understand the overall success of the OEP.

We also have laid the foundation for increased review and discussion of research that has the potential to provide capacity- and efficiency-enhancing solutions. Through the work of several groups across the aviation community, we will work to ensure that research assets are properly focused on solutions needed for the expansion of NAS capacity and improvement in NAS efficiency.

Finally, through renewal of our close collaboration with RTCA, we will work to improve the community's process for reviewing and commenting on OEP plans and commitments. Through our continued collaboration with industry, we will evolve the NAS in sensible and feasible ways to meet the needs of the aviation community and to achieve our mutual vision for aviation.

# Acronyms

| | |
|---|---|
| ADS | Automatic Dependent Surveillance |
| ARTCC | Air Route Traffic Control Center |
| ATC | Air Traffic Control |
| ATL | Atlanta Hartsfield Airport |
| ATN | Aeronautical Telecommunications Network |
| ATOP | Advanced Technology and Oceanic Procedures |
| BOS | Boston Logan International Airport |
| CAT I | Category One Landing |
| CAT II/III | Category Two/Three Landing |
| CCFP | Collaborative Convective Forecast Product |
| CDM | Collaborative Decision Making |
| CDMNet | Collaborative Decision Making Network |
| CDTI | Cockpit Display of Traffic Information |
| CEFR | CDTI Enhanced Flight Rules |
| CIW | Corridor Integrated Weather System |
| CLT | Charlotte/Douglas International Airport |
| CONUS | Continental United States |
| CPDLC | Controller Pilot Data Link Communications |
| CRCT | Collaborative Routing Coordination Tools |
| CVG | Cincinnati Airport |
| DFW | Dallas/Ft. Worth International Airport |
| DOD | Department of Defense |
| DRVSM | Domestic Reduced Vertical Separation Minima |
| DSP | Departure Spacing Program |
| DSR | Display System Replacement |
| EDA | En Route Dissent Advisor |
| EIS | Environmental Impact Statement |
| ETMS | Enhanced Traffic Management System |
| EWR | Newark International Airport |
| FAA | Federal Aviation Administration |
| FCA | Flow Constrained Area |
| FEA | Flow Evaluation Areas |
| FSM | Flight Schedule Monitor |
| GA | General Aviation |
| GDP | Gross Domestic Product |
| GSO | Greensboro Airport |
| HNL | Honolulu Airport |
| IAD | Washington Dulles International Airport |
| IAH | Houston Intercontinental Airport |
| ICAO | International Civil Aviation Organization |
| ILS | Instrument Landing System |
| ITWS | Integrated Terminal Weather System |
| JFK | New York John F. Kennedy International Airport |
| LA | Los Angeles |
| LAADR | Low Altitude Alternative Departure Route |
| LAAS | Local Area Augmentation System |
| LAHSO | Land and Hold Short Operations |
| LAS | Las Vegas McCarran International Airport |
| LDR | Limited Dynamic Resectorization |
| LGA | New York/LaGuardia Airport |
| LNAV | Lateral Navigation |
| MAMS | Military Airspace Management System |
| MCO | Orlando Airport |
| MEM | Memphis International Airport |
| MGDP | Multi-fix Ground Delay Program |
| MIA | Miami International Airport |
| MIT | Miles-in-Trail |
| MOA | Memorandum of Agreement |
| MOU | Memorandum of Understanding |
| MSP | Minneapolis-St. Paul Airport |
| NAS | National Airspace System |
| NASA | National Aeronautics and Space Administration |
| NCT | Northern California Tracon |
| NPRM | Notice of Proposed Rule Making |
| NRP | National Route Program |
| NY/NJ/PHL | New York/New Jersey/Philadelphia |
| OEP | Operational Evolution Plan |
| OES | Operational Evolution Staff |
| ORD | Chicago O'Hare International Airport |
| PARR | Problem Analysis, Resolution, and Ranking |
| PBO | Performance Based Organization |
| PCT | Potomac Consolidation TRACON |
| PDX | Portland Airport |
| PETAL | Preliminary Eurocontrol Test of Air/Ground Data Link |
| pFAST | Passive Final Approach Spacing Tool |
| PHL | Philadelphia International Airport |
| PHX | Phoenix International Airport |
| PRM | Precision Runway Monitor |
| RNAV | Area Navigation |
| RNP | Required Navigation Performance |
| RPM | Revenue Passenger Miles |
| RTAP | Runway Template Action Plan |
| RVR | Runway Visual Range |
| RVSM | Reduced Vertical Separation Minima |
| SAN | San Diego Airport |
| SDF | Louisville Kentucky Statson |
| SEA | Seattle-Tacoma International Airport |
| SF | San Francisco |
| SFO | San Francisco International Airport |
| SLC | Salt Lake City Airport |
| SMS | Surface Management System |
| SOIA | Simultaneous Offset Instrument Approaches |
| STARS | Standard Terminal Automation Replacement System |
| STL | St. Louis International airport |
| SUA | Special Use Airspace |
| TAAP | Tactical Altitude Assignment Program |
| TFM | Traffic Flow Management |
| TMA | Traffic Management Advisor |
| TMNL | Traffic Management National Log |
| TRACON | Terminal Radar Approach Control Facility |
| UPS | United Parcel Service |
| URET | User Request Evaluation Tool |
| VACAPES | Virginia Capes |
| VMC | Visual Meteorological Conditions |
| VNAV | Vertical Navigation |
| WAAS | Wide Area Augmentation System |
| WARP | Weather and Radar Processor ARTCC |
| ZAB | Albuquerque ARTCC |
| ZAN | Anchorage ARTCC |
| ZAU | Chicago ARTCC |
| ZBW | Boston ARTCC |
| ZDC | Washington ARTCC |
| ZFW | Ft. Worth ARTCC |
| ZHU | Houston ARTCC |
| ZID | Indianapolis ARTCC |
| ZJX | Jacksonville ARTCC |
| ZKC | Kansas City ARTCC |
| ZLA | Los Angeles ARTCC |
| ZLC | Salt Lake City ARTCC |
| ZMA | Miami ARTCC |
| ZME | Memphis ARTCC |
| ZMP | Minneapolis ARTCC |
| ZNY | New York ARTCC |
| ZOA | Oakland ARTCC |
| ZOB | Cleveland ARTCC |
| ZSE | Seattle ARTCC |
| ZTL | Atlanta ARTCC |

## DIRECTOR'S MESSAGE

December 2002

As we look back on the accomplishments of the Operational Evolution Plan (OEP) and plan for our challenging future, these words of Sir Winston Churchill come to mind:

"Every day you may make progress. Every step may be fruitful. Yet there will stretch out before you an ever-lengthening, ever-ascending, ever-improving path. You know you will never get to the end of the journey. But this, so far from discouraging, only adds to the joy and glory of the climb."

Despite the challenges facing our nation and the impact on our aviation industry, the FAA remains committed to the capacity enhancements presented in the Operational Evolution Plan, the OEP. We are taking advantage of this pause in demand growth to lay a foundation of new runways, innovative technology, and advanced operational procedures that will accommodate the inevitable return of aviation demand and facilitate economic growth.

Beginning this year, the Operational Evolution Plan defines a rolling ten year roadmap that builds upon the 2001 FAA commitments for improving capacity and efficiency in the National Airspace System (NAS). Now expanded out to the year 2013, version 5.0 is a clearer effort to align planned capacity enhancements with the future vision for airspace modernization. This future vision, called the NAS Concept of Operations and published by RTCA, is a government/industry roadmap for the future, guiding many of our policy and strategic decisions. Along with highlights of our progress over the past year, we include detailed descriptions for our commitments for initiative solutions and our plan for measuring the resulting benefits. In some cases, solutions have been redesigned to broaden the scope and optimize the use of existing equipage or to highlight related new operations. These are not changes that reduce our commitments; these changes align related activities and clearly define operational change.

Version 5.0 of the OEP is focused on operational changes that deliver capacity or efficiency benefits, while enhancing safety and security. We continue to believe that success for the aviation community requires close coordination and alignment of commitments and capabilities. In the past year, we have seen important advances:

ARRIVAL/DEPARTURE RATES

- During its first year in operation, the new Detroit runway increased the airport arrival rate by 14.3% under visual conditions and 10.4% under instrument conditions.
- All terminal choke point changes were completed and the delay reduction resulted in $65 million in annual savings.
- Traffic Management Advisor (TMA), which supports arrival metering and Optimizes traffic flow into the terminal airspace, is now operational at seven sites - producing about 5% capacity gains at Dallas-Ft. Worth, Minneapolis-St.Paul and Los Angeles, a 2% capacity gain at Denver.

User Request Evaluation Tool, a strategic look across multiple sectors, is now operational in six centers, providing reductions in lateral amendments that have saved nearly $2 million per month in Indianapolis and Memphis airspace. As a result of restriction removals at these two facilities, airlines have saved an additional $1 million per year.

EN ROUTE CONGESTION

- More web-based tools and information for managing congestion have been launched including the Route Management Tool, Coded Departure Routes, Collaborative Decision Making Network (CDMnet) for making collaborative decisions and other data sets.
- The Collaborative Convective Forecast Product is now available at http://fly.faa.gov/Operations/Weather/CCFP/CCFP_Images/ccfp_dmz.html.
- The Notice of Proposed Rule Making for Domestic Reduced Vertical Separation Minima (DRVSM) was posted in the Federal Register on May 10, 2002; next are three rounds of public hearings.

EN ROUTE SEVERE WEATHER

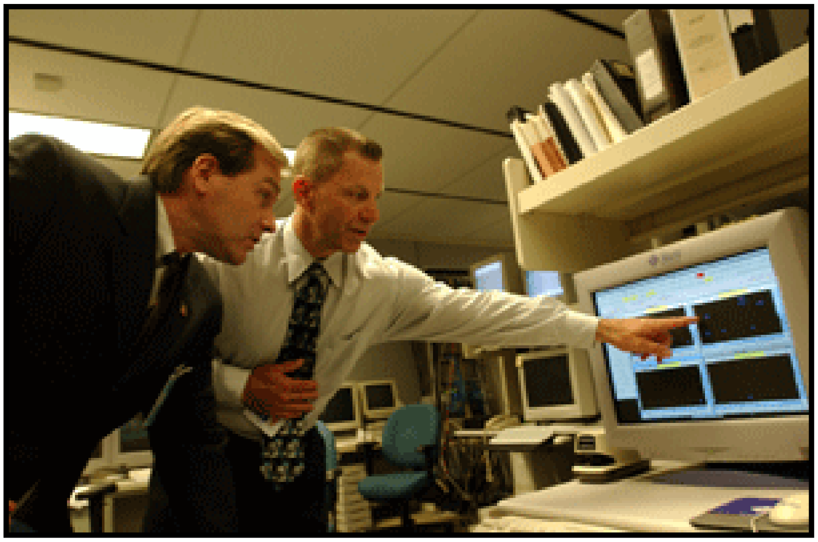
- The Precision Runway Monitor (PRM) which supports closely spaced runway operations in deteriorating weather was commissioned at Minneapolis, showing gains of four arrivals per hour.

AIRPORT WEATHER CONDITIONS

- The Integrated Terminal Weather System Product Team completed the first production unit in Atlanta.
- Runway Visual Range data, which disseminates weather information, was provided to users via CDMNet and is now available for 47 airports.
- The Combined Convective Forecast Product, showing weather data, is now on the FAA Command Center web site.
- Coded arrival and departure routes have been incorporated in the playbook to reduce impact of severe weather on flights not directly affected by storm activity and provide more options managing severe weather.

We look forward to greater coordination across all aviation stakeholders and airspace users as we strengthen our efforts to improve capacity, efficiency, safety and security in the airspace system. I invite you to use the Comment Form on the OEP web site to make sure we get your feedback and input. I also encourage you to return to this site regularly to see newly posted information and reports.

Charles E. Keegan
Director, Operational Evolution Staff



Charlie Keegan (left) at the FAA Tech Center with William Benner, Office of Innovations and Solutions, Weather Processors and Sensors Group, looking at the "three-level weather" that the Weather and Radar Processor (WARP) provides to the controller's Display System replacement (DSR) screens.

# Operational Evolution Plan
## Arrival Departure Rate

## AD-1
## Runway Additions Allow Improved Airport Configurations


Arrival and departure rates at the nation's busiest airports are constrained by the limited number of runways that can be in active use simultaneously. The addition of new runways at 12 airports between now and 2013 will expand airport throughput at the target airport, and possibly for other airports in the same metropolitan area. In most cases the new runways are sufficient to keep pace with forecast demand. But, half of the benchmark airports will not have new runways.

### Key Activities:

| | |
|---|---|
| Denver | 2003 |
| Miami | 2003 |
| Orlando | 2003 |
| Houston | 2003 |
| Cleveland | 2004 |
| Minneapolis | 2004 |

### Smart Sheet:
### Version 5.0, December 2002

### AD-1: Build New Runways

**New Runways allow improved airport configurations.**

### Background

The 35 airports included in the OEP account for seventy-three percent of all passenger enplanements. Much of the delay to air traffic can be traced to inadequate throughput (measured as arrival and departure rates) at these airports. The construction of new runways is the most effective method of increasing throughput.

### Ops Change Description

A new runway at an OEP airport is included in the OEP when the FAA is reasonably certain of the location, dimensions, timing, and planned use of the runway. There are twenty-two runways being considered at the 35 OEP airports, however, the FAA is reasonably certain of only 12 of these runways. These 12 runways are included in the OEP and are identified in the table below. The remaining 10 runways will be included in the OEP when the runway meets the certainty criteria described above. Of the 12 OEP runways, 9 are under construction, 1 is scheduled to begin construction shortly, 1 has begun the environmental process, and 1 recently completed the environmental process. These new runways will improve the throughput for the airport and for national airport system overall.

### New Runways Included in the OEP

| Airport | Runway | Environmental Status | Year ConstructionTo Begin | Year Runway to Open | Capacity Improvement (Percentage) |
|---|---|---|---|---|---|
| Denver (DEN) | 16R/34L | ROD issued 2000 | 2000 | 2003 | 18% in VFR; 4% in IFR |
| Miami (MIA) | 8/26 | ROD issued 1998 | 2001 | 2003 | 10% in VFR; 20% in IFR |
| Orlando (MCO) | 17L/35R | ROD issued 1990 | 2000 | 2003 | 23% in VFR; 34% in IFR |
| Houston (IAH) | 8L/26R | ROD issued 2000 | 2001 | 2003 | 35% in VFR; 37% in IFR |
| Minneapolis (MSP) | 17/35 | ROD issued 1998 | 1999 | 2004 | 29% in VFR; 26% in IFR |
| Cleveland (CLE) | 6L/24R | ROD issued 2000 | 2001 | 2004 | N/A |
| Boston (BOS) | 14/32 | ROD issued 2002 (3) | 2003 | 2006 | 0% in VFR; 0% in IFR |
| Cincinnati (CVG) | 17/35 | ROD issued 2001 | 2003 | 2005 | 26% in VFR; 26% in IFR |
| St. Louis (STL) | 12R/30L | ROD issued 1998 | 2001 | 2006 | 14% in VFR; 84% in IFR |
| Atlanta (ATL) | 10/28 | ROD issued 2001 | 2001 | 2006 | 31% in VFR; 27% in IFR |
| Washington (IAD) | 1W/19W | EIS underway | 2005 | 2007 | 46% in VFR; 54% in IFR |
| Seattle (SEA) | 16W/34W | ROD issued 1997 | 1998 | 2008 | 52% in VFR; 46% in IFR |

(1)The dates are supplied by the airport sponsor and are contingent on the issuance of a favorable environmental record of decision by the FAA.
(2)The source of the capacity improvement percentage is the Airport Capacity Benchmark Report 2001 (Table 2).
(3) There are 3 separate legal challenges to this project, one of these is a challenge to the adequacy of the Final Environmental Impact Statement (FEIS) and Record of Decision (ROD).

### Scope and Applicability

- A runway is included in the OEP when the FAA is certain of the following 4 criterion: 1) location; 2) dimensions; 3) timing; and 4) planned use of the runway.
- Once a new runway is included in the OEP a horizontal integration team is established. The

integration team is comprised of all involved FAA lines of business along with a military representative. The team develops a runway template action plan (RTAP) comprised of tasks that must be considered when commissioning the runway and assigns accountability to the airport, airline, and FAA allowing early identification and resolution of issues that might impact the runway schedule. Quarterly meetings are held with the stakeholders (airports and airlines).

- Ten other runways or runway reconfigurations are being considered at OEP airports (CLT, SFO, DFW, BWI, LAX, TPA, ORD, PHL, IAD and DEN) in addition to the 12 runways already included in the OEP.
- A new runway at Boston Logan will reduce delay in certain runway configurations but is not expected to increase the optimum capacity of the airport.
- Runway extensions (i.e., lengthening an existing runway) are not explicitly identified here, but can improve capacity by allowing use by larger aircraft or by eliminating runway intersections. Several OEP airports have runway extensions underway.

## Key Decisions

- Identification of procedures, navigational equipment, and staffing to realize the benefit of a new runway.
- The FAA schedule for the development of procedures, deploying navigational equipment, and ensuring adequate staffing. Airline's scheduling, training, and familiarization of pilots with new terminal and surface routes and procedures. The OEP provides the coordination mechanism to ensure that these measures are in place when the runway is scheduled to open.

## Key Risks

- Environmental analysis must be completed before a new runway can be built. Typically, new runways have a high degree of environmental controversy and are frequently subject to legal challenges.
- Experience has shown that projected opening dates frequently change due to unforeseen circumstances at the local level.
- Dependency for full benefits on operational procedures that have not yet achieved full acceptance by pilots and controllers.

## Responsible Team

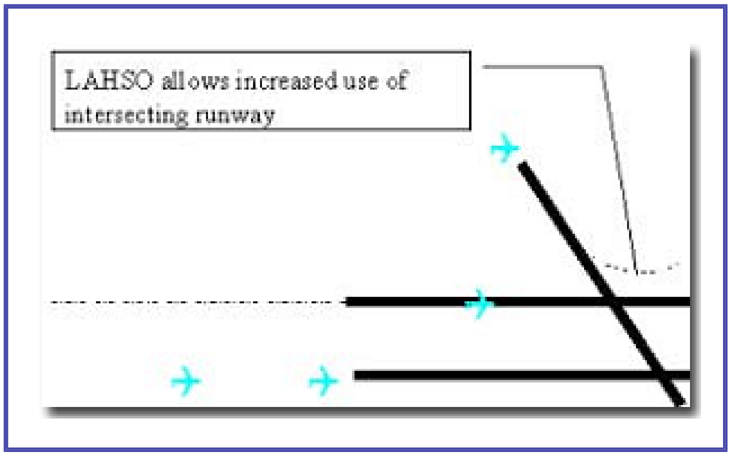
***Primary Office of Delivery***
Paul Galis, ARP-1

***Support Offices***
ARC-1
AFS-1
AAF-1
ATP-1
ATA-1
ATB-1
ASC-1

***Working Forums***

***Other Websites***
Relationship to the Architecture

## AD-2
## Use Crossing Runway Procedures




A means for increasing capacity is to make more use of existing runways. Procedures for use of crossing runways under different conditions, Land and Hold Short Operations (LAHSO), are in use at over 200 airports today. These procedures greatly increase the number of arrivals and departures that can be handled without interfering with intersecting traffic.

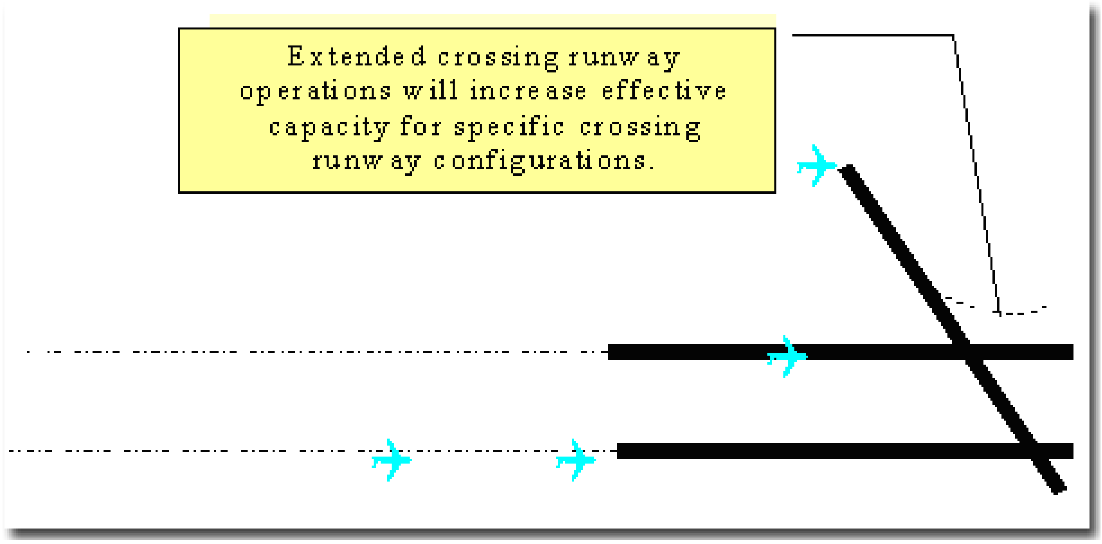
### Key Activities:

| | |
|---|---|
| Evaluate other alternatives | 2003 |
| Conduct surveys and develop test plans for initial site procedures: ORD, MIA, HNL, LAS | 2003 |
| Conduct safety analysis initial sites. | 2003 |
| Develop and publish new National Criteria for crossing runway procedure. | 2004 |
| Conducting safety analysis at remaining locations. | 2004 |

### Smart Sheet:
### Version 5.0, December 2002

**AD-2: Use Crossing Runway Procedures**

Extended crossing runway procedures increase use of crossing runways in specific configurations.




## Background

Simultaneous Operations on Intersecting Runways (SOIR), either two simultaneous landings or one airplane landing while another was taking off, have been applied to increase airport capacity since 1968. In 1997, to increase efficiencies for intersecting runway operations, the FAA changed some procedural conditions for conducting SOIR and renamed the program Land and Hold Short Operations (LAHSO). LAHSO procedures operate today under FAA published order 7110.118 at 215 airports in 785 intersecting runway configurations. In 1998, there was a change to LAHSO resulting in the loss of throughput capability at specific airports and in specific configurations. There is an effort underway to explore other procedures and technologies to reclaim lost capacity.

## Ops Change Description

Intersecting runway procedures (beyond current LAHSO definitions) may improve throughput at specific airports (there are 18 airports and a total of 34 configurations that conducted LAHSO prior to 1998 that do not currently use LAHSO).

The scope of this activity is not to change current LAHSO procedures or operations, but to explore the safety and other operational issues with further application of procedures in crossing runway operations that are not covered r used in current FAA operations.

## Benefits, Performance and Metrics

- Expanded use of operations on intersecting runways adds arrival capacity approaching levels for a dependent runway, but will vary with location and airport configuration. It provides an increase in throughput.

## Scope and Applicability

- FAA will work with labor and users to address the development, assessment, certification and implementation of new procedures at specific sites. The goal is to develop the ways and means to increase operational efficiency at these specific locations.
- Users must collaborate with FAA Air Traffic Procedures to define procedures to make more aircraft types or intersecting runways eligible for intersecting runway operations.
- FAA's Air Traffic Planning and Procedures (ATP) and Flight Standards (AFS) divisions will develop a joint plan for investigating new ways and means to enhance crossing runway operations (6/03).

Primary focus for this activity will be on the following locations:

| | | | | |
|---|---|---|---|---|
| BWI | LAS | DTW | BDL | MIA |
| HNL | LGA | MSP | BOS | TPA |
| IAD | PIT | ORD | BNA | |
| JFK | CLE | PHL | FLL | |

- There are four initial sites for discussion and development of new crossing runway procedures, O'Hare, Miami, Honolulu, and Las Vegas. AFS/ATP representatives from FAA headquarters have conducted initial visits and discussions at . It is expected that procedures will be developed, assessed, and implemented on a site/configuration basis.

- After discussions and site visits, a plan will be developed for the assessment of the new procedure(s) on a site by site basis. This plan will include initial simulation assessments, formal safety assessments, and, if supported, initial operational assessment.

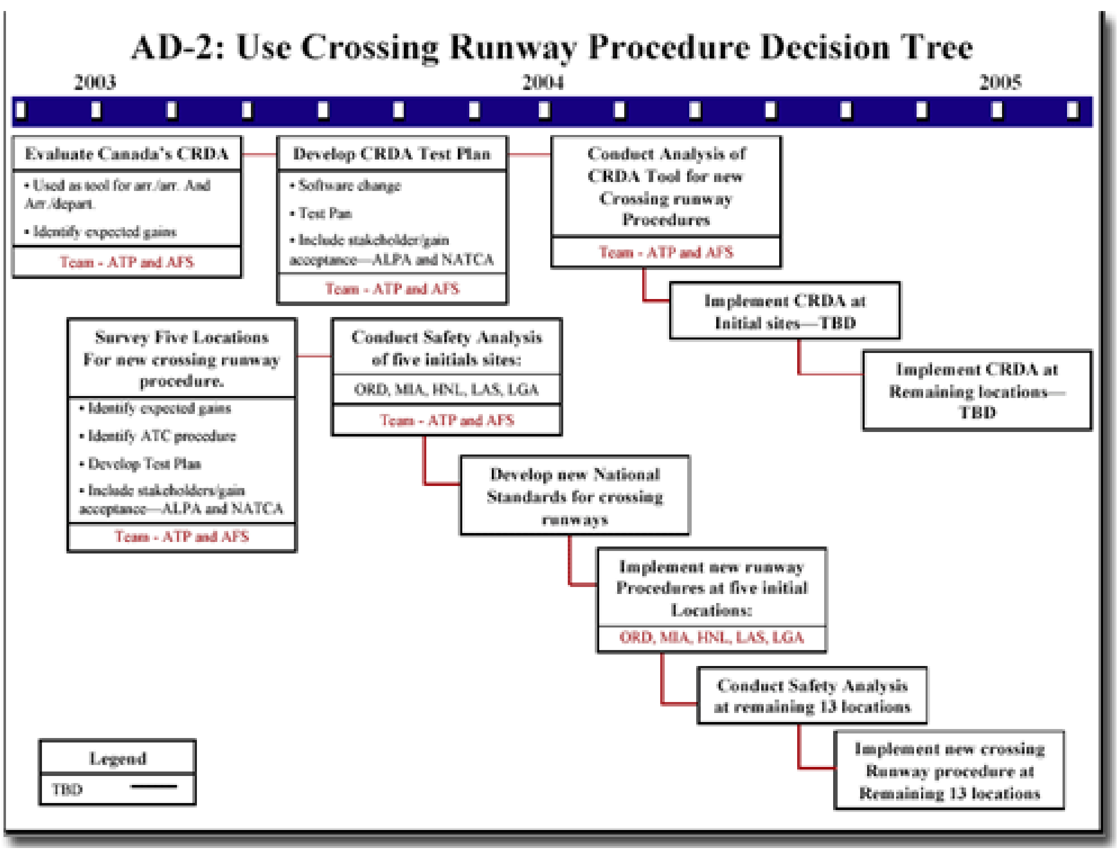
## Key Decisions

- Identification of new procedures to be evaluated.
- Pilot and controller acceptance of roles and responsibilities. The determination of roles and responsibilities needs to involve both pilots and controllers groups. This involvement allows technical and operational input addressing human factors and other issues from both groups to be used in mitigating workload and other safety issues.

## Key Risks

- Determining operational procedures acceptable to pilots and controllers

## Decision Tree



[View enlarged decision tree]

**Responsible Team**
**AD-2**
**Use Crossing Runway Procedures**

***Primary Office of Delivery***
Jim Ballough, AFS-1

Robert Swain, AFS-400,
Lead Specialist: Flight Technologies and Procedures Division

***Support Offices***
ATP-1, Mike Cirillo
ATB-1, Bill Voss
AFS-400, John McGraw

***Working Forums***

***Other Websites***
[Relationship to the Architecture]

## AD-3
## Redesign Terminal Airspace and Routes

Designing routes and airspace to reduce conflicts between arrival and departure flows can be as simple as adding extra routes or as comprehensive as a full redesign where multiple airports are jointly optimized. New strategies exist for taking advantage of existing structures to depart aircraft through congested transition airspace. In other cases, area navigation (RNAV) procedures are used to develop new routes that reduce flow complexity by permitting aircraft to fly optimum routes with little controller intervention. These new routes spread the flows across the terminal and transition airspace so aircraft can be separated to optimal lateral distances and altitudes in and around the terminal area. In some cases addition of new routes alone will not be sufficient, and redesign of existing routes and flows are required. Benefits are multiplied when airspace surrounding more than one airport (e.g., in a metropolitan area) can be jointly optimized.

**Key Activities:**

| | |
|---|---|
| PCT Airspace | 12/03 |
| NY/NJ/PHL Redesign Draft EIS | 12/03 |
| STL MAP EIS Complete | 11/04 |
| MCO Airspace to Support Runways | 10/03 |
| Houston Airspace to Support Runway | 10/03 |

**Smart Sheet:**
**Version 5.0, December 2002**

**AD-3: Redesign Terminal Airspace and Routes**

**Optimize and redesign terminal airspace to expedite arrivals, departures, and transitioning to en route airspace.**

**Background**

Current congestion in transition and en route airspace often limits the ability to get departing aircraft off the ground. Similarly, airspace congestion can limit arrivals, even if runway capacity is available. In many terminal areas today, arrival and departure procedures overlap either because they were designed for lower volumes and staffing, or because they are based on ground-based navigation. These routes are strongly interdependent. Many airports have common departure fixes or arrival fixes that must service a variety of aircraft types with different performance characteristics. By requiring departures to navigate or funnel through common departure fixes, the throughput rates at the airports involved must be suppressed. Similar problems exist with arrivals.

Complex arrival and departure routes create challenges to flights transiting through and transitioning from terminal airspace. Efficient operations in terminal airspace will require not only redesigning routes, but also changing the size and shape of the airspace. Expanding the boundaries of terminal airspace - through reassignment, integration, or consolidation – adds flexibility and capacity through use of terminal rules and separation standards.

**Ops Change Description**

The operational change described here includes two concepts to reduce interdependencies between arrival and departure flows:

- AD-3.1: Implement RNAV routes
- AD-3.2: NAR – Optimize and Redesign Terminal Airspace

Where volume has increased and the current airspace structure is the limiting factor, redesigning arrival and departure procedures, including the addition of RNAV and RNP procedures, will allow for more efficient use of the constrained terminal airspace. Benefits associate with these changes will be dependent on the level of equipage of airspace users. While non-equipped users will be accommodated, airspace and procedures will be designed to maximize benefits for those that choose to equip.

Terminal airspace optimization and redesign is a foundation component of the National Airspace Redesign (NAR). NAR is the FAA initiative to review, redesign, and restructure the nation’s airspace. NAR will leverage new technologies, equipage, infrastructure, and procedural developments to maximize benefits and system efficiencies. Modernization of airspace through NAR is characterized by the migration from constrained ground-based navigation to the freedom of an RNP based system.

Terminal airspace optimization efforts are ongoing initiatives to ensure the airspace design and use is effective for transitioning aircraft to and from the associated airport or airports. Terminal airspace redesign is a major undertaking to develop a structure that takes full advantage of new runways, evolving technologies and aircraft capabilities. This redesign will provide flexibility for system users to efficiently transition into and out of terminal airspace while making maximum use of airspace and airport capacity. Key characteristics of NAR terminal optimization and redesign are:

- Moving or adding arrival and departure routes, in support of new runways, procedures (e.g., SOIA) and to exploit technology enhancements (e.g., PRM)
- Redesigning sectors to better manage flows
- Realigning airspace to enhance flow management through airspace

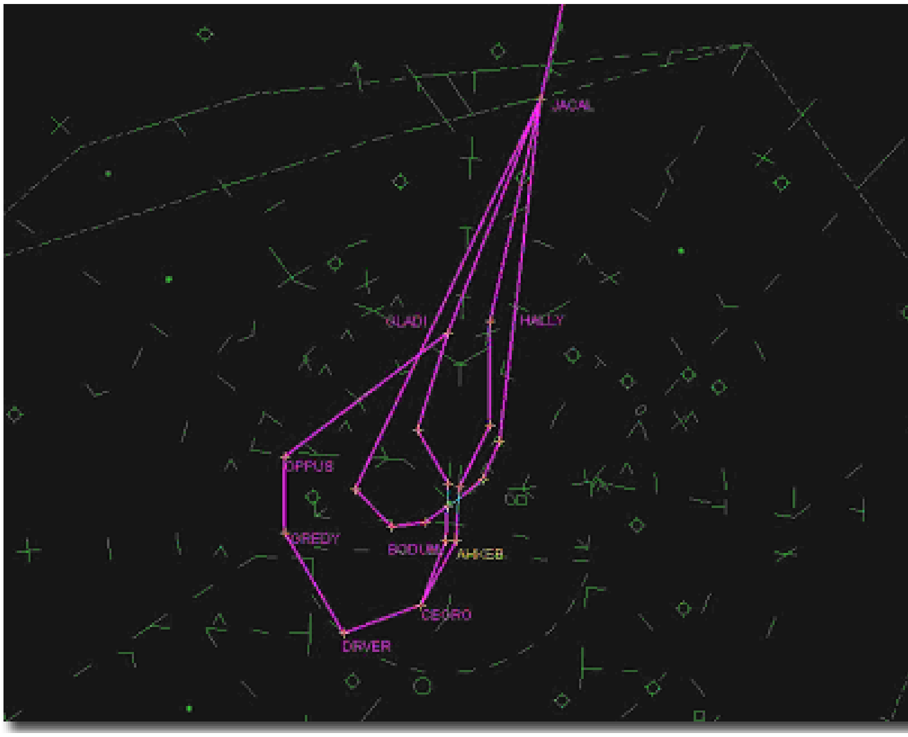
Where appropriate, terminal airspace projects are considering reassigning airspace currently controlled by en route facilities and releasing airspace responsibility to adjoining terminal control facilities. This airspace redefinition will reduce separation, coordination, intermediate level-offs, and other TRACON to center handoff restrictions. There are three types of terminal airspace redefinition included in terminal airspace modernization:

- Reassigning en route airspace to terminal facilities (does not require consolidation of facilities)
- “Terminalization of the airspace” through integration of terminal and en route airspace, operations, personnel and functions.
- Consolidation of airspace between terminal facilities.

### Benefits, Performance and Metrics

- Reduce arrival and departure delays
- Increase airport capacity and utilization effectiveness
- Reduced excess gate times (duration an/or occurence)
- Improved predictability

### AD-3.1 Implement RNAV Routes




### Scope and Applicability

RNAV allows for the creation of arrival and departure routes (specifically, allowing multiple entry to existing and STAR and multiple exits from Departure Procedures (DPs)) that are independent of present fixes and navigation aids. Airports with complex, multiple runway systems, or with shared or congested departure fixes benefit the most through segregating departures and providing additional routings to reduce in-trail separation increases during climb. Participation and benefits are subject to aircraft equipage levels, pilot/controller education.

Design, evaluation and implementation of RNAV arrival and departure routes is ongoing across the United States. Current publication plans include:

- 40 RNAV routes by the end of 2002
- An additional 30 routes by the end of 2003
- An additional 30 routes by the end of 2004
- The current list of procedures, by airport and runway is included on the OEP web page. Operational benefits from these procedures will depend on actual usage of the published routes.
- In the mid-term, the FAA will be developing criteria for lower RNP values for arrivals and departures.

### Key Decisions

- Identify user equipage required to deliver desired benefits. Users must equip to meet RNAV DP/STAR design criteria.
- Manufacturers and users must complete avionics certification – ARINC 424 (for new leg types).
- Additional DMEs may be required to obtain required coverage for RNP and RNAV routes. Airways Facilities also must address maintenance policies to provide information on DME availability (with

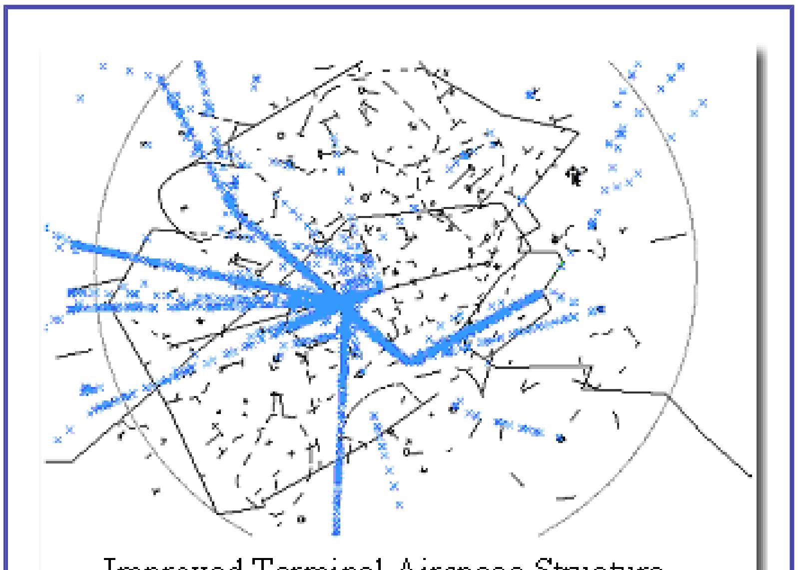
regard DME auto-tuning).

- An eighteen-step process that identifies specific points for stakeholders (represented by a lead carrier) have input into design and implementation decisions defines the RNAV design process. These decisions include input of route design and flyability, and vary with each airport and route.

### Key Risks

- Environmental assessment for new routes and procedures will be required. If the level of assessment is significant then implementation timeframes will increase accordingly.
- Segregated routes based on equipage may penalize non-equipped users. If equipage is mandated then rulemaking will be required and time to implement will be extended. AOPA has indicated possible acceptance of RNP equipage being necessary to access major congested airports. However they must maintain access to key GA airports (e.g., TEB) located in close proximity to potential equipage-mandated airports.
- Several ground and cockpit systems must be in place or may cause risks in delivery. If Flight Management Computers (FMC), ATC Host/ARTS automation adaptation and display of RNP status, and STARS adaptation and display of RNP status are not in place, routes may be published, but usage and realized benefits will be limited.

### AD-3.2 Optimize and Redesign Terminal Airspace



Improved Terminal Airspace Structure

### Scope and Applicability

Terminal airspace structures control the efficient transitioning to and from the nation's airports. Approximately 90% of delays are experienced at the NAS hub airports. Demand is expected to increase by 200 million passengers at these airports over the next decade. While new runways are planned for several of these airports, evolution of the supporting terminal airspace structure and procedures will be necessary to provide expected capacity gains. Terminal airspace optimization (mid-term) and redesign (long-term) projects are ongoing across the United States. These airspace projects while addressing problems in the terminal airspace may include associated changes in the en route airspace (see ER1). Efforts are planned for all major metropolitan areas and congested terminal areas servicing key airports, focusing on the airspace associated with the 35 Benchmarked airports. These projects include:

| | | |
|---|---|---|

| | | |
|---|---|---|
| SAN East Arrival | 2002/2003 | SAN |
| SEA-PDX Tower En Route | 2002/2003 | SEA, PDX |
| Denver South Airspace | 2002/2003 | DEN |
| LAX Departures | 2003 | LAX |
| LAX Independent Flows | 2003 | LAX |
| PCT Airspace | 2003 | IAD, BWI, DCA |
| Salt Lake Four Corner Post | 2003 | SLC |
| Houston Redesign - HAATS | 2003 | IAH, HOU |
| CVG Runway | 2003 | CVG |
| MIA 4th Runway | 2003 | MIA, FLL |
| MCO 4th Runway | 2003/2004 | MCO |
| SBA Expansion | 2004 | SBA |
| Omaha Airspace | 2004 | OMA |
| Portland TRACON | 2004 | PDX |
| BCT Airspace | 2004 | BOS, MHT |
| ATL, CLT, GSO Runways | 2005 | ATL, CLT, GSO |
| NY/NJ/PHL Metropolitan Redesign | 2005/2006 | JFK, EWR, TEB, LGA, PHL, MMU, ISP |
| Midwest Airspace Plan (STL) | 2006 | STL |
| AGL Midwest Expansion | 2007 | MDW, ORD, MSP, DTW, CVG, PIT, CLE |
| NYICC | 2008/2009 | |

The dates listed above reflect projects schedules updated in August 2002. Dates will be revalidated with regional teams and are subject to change based on resource availability.

Of the projects listed in the table above, the following include redefinition of terminal airspace boundaries:

- Reassigning en route airspace to terminal facilities (does not require consolidation of facilities) HAATS, SBA Expansion, NCT Internal Airspace
- Consolidation of airspace between terminal facilities. PCT Airspace and BCT Airspace

Terminalization is being considered primarily for the New York Integrated Control Complex (NYICC). NYICC is a project exploring the integration of the New York terminal and en route air traffic control functions, personnel, and facilities. In conjunction with the NY/NJ/PHL Metropolitan Airspace Redesign Project, NYICC will provide significant operational benefits: reducing congestion, minimizing delays, improving routing, while maintaining the highest levels of safety and security. Current proposed implementation for NYICC is in 2008/2009.

### Key Decisions

- The airspace design process under NAR has several points where industry, the user community and other stakeholders are asked to provide input to key decisions. Using informal methods (e.g., briefings and informational meetings) and formal methods (e.g., working with RTCA, advisory committees and public meetings), NAR teams strive to communicate plans and receive appropriate feedback. Ultimately the implementation decision responsibility lies with the FAA. The three critical decision points involving stakeholders are:
    - Characterizing the problem: this activity occurs in the first few months of an airspace project where NAR teams work with stakeholders to affirm project objectives.
    - Designing the alternative design options that will become the proposed change: here stakeholders are asked for input through scoping meetings and regular meetings with key constituencies.
    - Assessing the impact of the proposed change: once analysis has been complete,

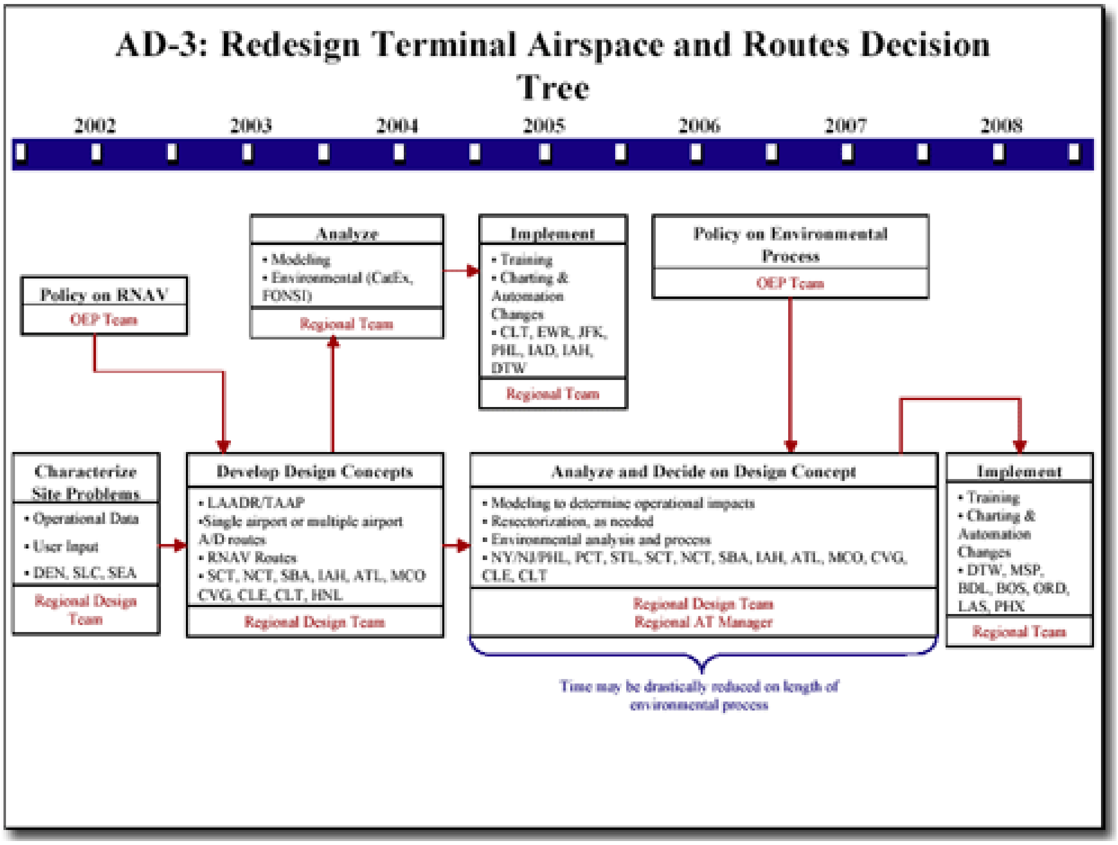
stakeholders receive feedback on impacts and pending FAA decisions.

- Pending JRC decisions associated with new buildings and infrastructure changes.

## Key Risks

- Several infrastructure adjustments will be needed to support new sectors, including availability of building space, ATC automation, controller position equipment, and additional frequencies. If these systems are not available, then the ability to transition to new sectorization or to implement additional sectors will be negatively impacted. Limitations of the current systems, specifically the HOST computer, will limit potential efficiency of some of the proposed airspace changes.
- Affordability of proposed consolidation of operations is a risk. Cost-benefit assessment of the consolidation and terminalization concepts must be completed.
- Several infrastructure changes will be required to implement consolidation and terminalization projects. Current plans have identified these needed changes and teams are being formed to conduct necessary analysis. If these infrastructure changes are not made, implementation of proposed changes will be delayed, or design changes will need to be rescoped. Issues being examined include:
    - Rerouting communications and radar data to the consolidated facility
    - Providing the kind of radar coverage that would permit use of three-mile separation throughout the airspace in question, including the surveillance data processing that would be required.
    - Providing flight data processing for the consolidated facility.
    - Creating the necessary infrastructure (e.g., power supply, cooling) associated with the building in which a consolidated facility would reside.
- Environmental assessment for new routes and adjusted traffic flows will be required. If the level of assessment is significant then implementation timeframes will increase accordingly.
- NATCA has stated that they do not support additional TRACON consolidation. If NATCA is not involved in planning and development of airspace, implementation will be delayed.

## Decision Tree




[View enlarged decision tree]

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***Other Websites***
Relationship to the Architecture
www.faa.gov/ats/nar/
www.faa.gov/ats/atp/RNAV.cfm

## AD-4
## Fill Gaps in Arrival and Departure Streams

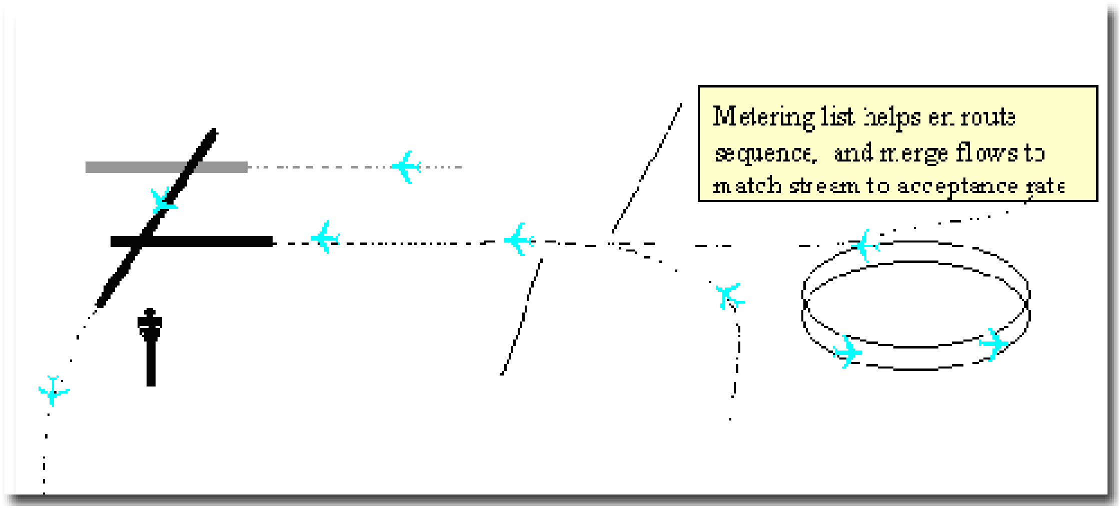
Automated decision support tools provide controllers more information on airport arrival demand and available capacity for making decisions on aircraft spacing. Improved sequencing plans and optimal runway balancing increase arrival and departure rates as much as ten percent. Free Flight tools will help air traffic controllers balance runway use and sequence aircraft according to user preferences and airport capacity.

### Key Activities:

| | |
|---|---|
| Single Center TMA at ZHU | 8/2003 |
| Single Center IDU TMA at ZID | 11/2005 |
| Single Center TMA at ZME | 5/2006 |
| Single Center TMA at ZKC | 12/2006 |

**Smart Sheet:**
**Version 5.0, December 2002**

### AD-4: Fill Gaps in Arrival and Departure Streams




### Background

During periods of high traffic demand, realizing the full potential throughput at an airport requires the controller to space aircraft at the minimum required for safety. At most locations, controllers rely on experience and their ability to extrapolate the future position of aircraft to develop spacing plans and to execute these plans. Research on automated decision support tools has shown that controllers can improve their planning, which results in improved throughput.

### Ops Change Description

Controllers and TMCs will have improved information on arrival and departure demand and on available capacity. Decision support tools will assist them in developing improved sequencing. These plans will reflect an improved ability to project the future position of the aircraft, to optimize use of runways and fixes, and to account for separation requirements based on aircraft weight classification. The result will be an improved balancing of the airport runway assets and an increase in the airport throughput rate for both arrivals and departures. In addition, the execution of the plan will be improved through the provision of tools that show controllers the delay required for each aircraft. Arrival metering will transition from being mileage based to being time based.

- **AD-4.1:** Metering and Merge Planning—Traffic Management Advisor – Single Center (TMA-SC) will provide a metering plan to TMCs and provide information to controllers on aircraft scheduled arrival times, undelayed arrival times, and required delay absorption to meet the arrival schedule. A planned enhancement to TMA, Traffic Management Advisor- Multi Center (TMA-MC) will support metering at airports where arrival scheduling and delay absorption occurs in the airspace of more than one center. TMA-MC will provide advisory information to controllers which is similar to that provided by TMA-SC, with the enhancement that the advisories are available to controllers in multiple ARTCCs. These distributed advisories collectively implement a coordinated plan for managing arrivals to a given airport.

### Benefits, Performance and Metrics

- Due to improved information from TMA to TMC's and controllers, arrival rates will increase 5 percent. Estimated improvements are based on results from implementation at Free Flight Phase 1 sites.
- Airport peak operations rate will increase.
- Reduction in departure delay for flights released by the ARTCC.
- More efficient delay distribution in transition airspace.

### AD-4.1 Metering and Merge Planning

Decision support tools provide the TMC with a metering plan and the controller with information on the required delays for each aircraft (also see ER-7.2).

### Scope and Applicability

- TMA (Traffic Management Advisor) is applicable for airports where arrival demand regularly exceeds capacity.
- TMA-SC (Traffic Management Advisor – Single Center) near-term and mid-term locations include: ZFW-DFW (complete), ZMP-MSP (complete), ZDV-DEN (complete), ZMA-MIA (operational), ZOA –SFO (operational), ZLA-LAX (complete), and ZTL-ATL (operational). Transition to time based metering is required to complete ZMA, ZOA, and ZTL.
- Additional arrival sites will require site specific adaptation. FFP2 plans to deploy TMA-SC to support arrivals at the following airports: ZME-MEM, ZKC-STL, ZID-CVG, and ZHU-IAH. In FY03 FFP2 will deploy TMA-SC to ZHU-IAH. ZID-CVG, and ZME- MEM will be deployed in

FY2006. ZKC-STL will follow in FY 2007.

- TMA-MC (Traffic Management Advisor –Multi Center) will enhance TMA to work in areas where the airport is close to the center boundaries and where arrival flows interact with flows to other airports. RTCA recommended TMA for several sites that require TMA-MC capability, these include Washington area airports, N90 airports, PHL, DTW, SDF, BOS, and PIT. NASA is developing TMA-MC with emphasis on PHL airspace; this capability will be evaluated in 4 ARTCCs and PHL TRACON in FY 2003 and 2004 TMA-MC will provide advisory information to controllers which is similar to that provided by TMA-SC, with the enhancement that the advisories are available to controllers in multiple ARTCCs. These distributed advisories collectively implement a coordinated plan for managing arrivals to a given airport.

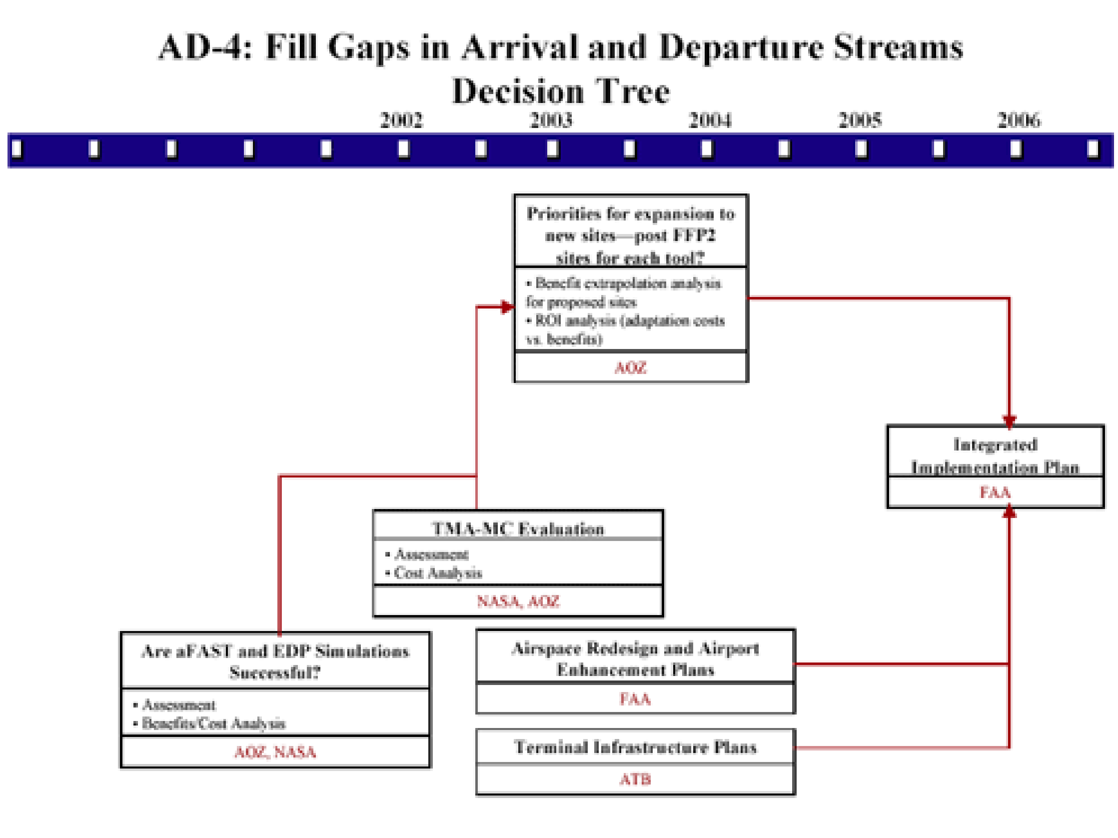
### Key Decisions

- Priorities for TMA deployments beyond the current FFP2 Baseline
- Investment decision to enhance TMA-SC baseline with TMA-MC functionality prior to 12/05.

### Key Risks

- NASA is currently researching TMA-MC. Implementation is dependent on the success of this research and on NASA participation in technology transition.
- New York and Philadelphia redesign activities will result in changes to TMA adaptation and therefore work in these areas needs to be coordinated. Transition to use of metering tools requires substantial facility commitment and resources for adaptation, procedural development, and training.

### Decision Tree




[View enlarged decision tree]

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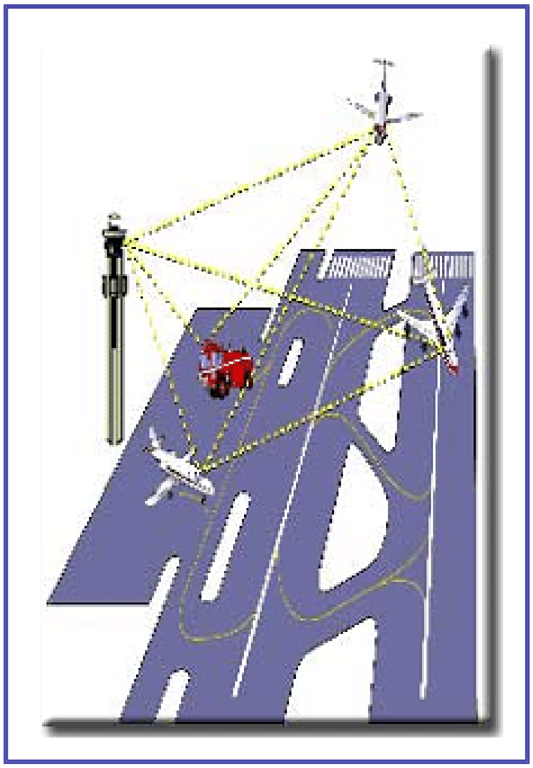
***Working Forums***
RTCA

***Other Websites***
[Relationship to the Architecture]
RTCA
Free Flight Program Office

## AD-6
## Coordinate for Efficient Surface Movement



New tools for airport surface traffic management will provide airport personnel the capability to predict, plan, and advise surface aircraft movement. Animated airport surface displays for all vehicles on the ground will display information in real time to all parties of interest. Displays of aggregate traffic flows on the surface will help project demand and balance runways and arrival and departure flows more efficiently. In addition, these new tools will be shared with flight operations centers to provide a common situational awareness and collaborative decision making and allow all parties to anticipate and plan for impacts in advance.

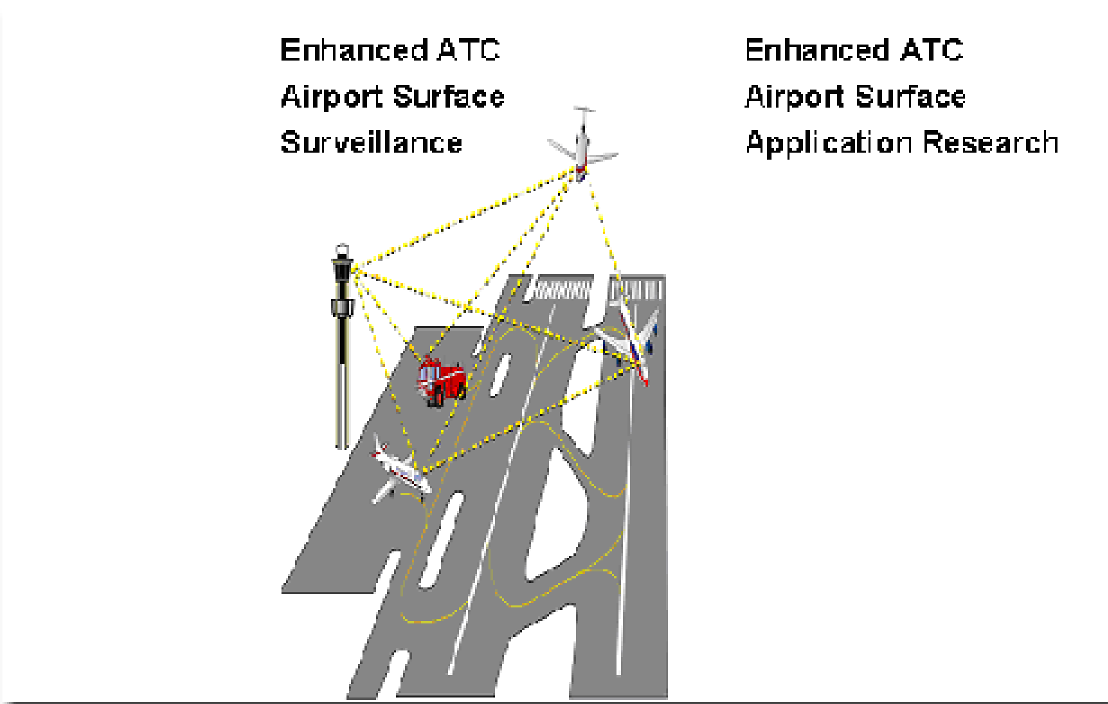
### Key Activities:

| | |
|---|---|
| Definition of Surface Movement System and Interfaces | 2002 |
| Surface Movement Trail in Memphis | 2003 |
| Independent Cost/Benefit Analysis Completed | 2004 |
| Deployment Decision for Surface Movement System | 2004 |

**Smart Sheet:**
**Version 5.0, December 2002**

### AD-6: Coordinate for Efficient Surface Movement

**Improved planning, movement, and decision-making due to improved situational awareness of surface operations.**




### Background

The airport surface is one of the few remaining areas of the NAS without adequate surveillance, precluding tactical and strategic decisions by the service provider. Information regarding identification, position, movement, and intent of aircraft and surface vehicles is maintained solely through controller observation and verbal communication. Even at airports with surface surveillance, controllers must rely on pilots and vehicle operators for position reports to validate their mental picture and, where available, a limited situation display to make control decisions. In addition, the lack of easily accessible planning information (including information on pushback, taxi, departure, and arrivals) results in inefficiencies for flight planning and scheduling, gate management, control, and servicing of aircraft. These uncertainties in surface movement contribute not only to an inefficient use of runways and taxiways, but also result in conflicting decisions with the arrival and departure functions due to demand projections based on inaccurate surface estimates.

The following are goals for surface operations: is to provide support to all ground control facilities; provide insight to the Tower and TRACON of the expected departure sequence; improve all strategic flow planning by adding increasing levels of certainty to future flight trajectories by having real data on intentions at least to the gate and even further; to support the establishment of runway assignment and sequence to assist both ground and arrival/departure flow initiatives and as stated in the NAS Concept of Operations, to reduce constraints on the user when airport resource (runway, taxiway, gate, etc.) demand is high. Elimination of these constraints by a migration from a strictly procedural environment to an automated, collaborative environment would minimize the overall ground delay of arrivals and departures, while incorporating user business model preferences.

## Ops Change Description

### 1) Situational awareness for ground controllers

The establishment and distribution of real-time surface surveillance information will increase ground efficiency. Implementation of a seamless, real-time surface surveillance capability will reduce the range of uncertainty with regard to surface movement and resource demands.
For air traffic controllers positive identification and accurate real time position information for aircraft and surface vehicles will result in better and timelier decision making for surface operations. Controllers will need to request fewer position reports and be able to monitor and quickly identify aircraft, for example: aircraft exiting runways after landing that are contacting ground control, or positive identification of departing aircraft at the runway. The access to this information will allow for greater efficiency in taxiing and departure and ramp queue management since the taxi path clearance can be tailored and monitored automatically to achieve throughput objectives. Planning and proactive control of surface traffic is made possible when controllers know the position of aircraft before initial communication/contact is made.

### 2) Queue information for tower and TRACON

Surface surveillance with positive identification of targets also provides the basis for developing accurate and automatically updated aircraft timelines for use by local Traffic Management specialists to manage the flow of traffic to and from the surface. The real time availability of airport and runway queue information is also invaluable for operations in large TRACONS or where coordination of activities between multiple facilities is required. The generation of the information automatically ensures that it is timely and accurate.

### 3) Event information for Collaborative Decision Making (CDM)

For both Flight Operations Centers (FOC) and Traffic Management Coordinators (TMC), the availability of real-time surface surveillance information will support the development and implementation of applications designed expressly to improve traffic management and projections across all phases of flight. By adding information on both the individual flight movement and the aggregate flow on the surface, this knowledge can be incorporated more accurately into the operational planning and decision process over 20 minutes earlier. The result is a vastly improved ability to project and identify periods of excess demand and other congestion. The more accurate, common situational awareness of the impacts across all phases of NAS operation. will be directly reflected in more extensive CDM.

### 4) Surface Management Systems (SMS) to improve surface management and integrate the airborne arrival/departure flow initiatives

The availability of both surveillance and event information supports the development of SMS that can forecast queue, taxiway, and runway congestion. It will also provide alternatives for departure runway and taxi paths, as well as identify and offer queue ordering to meet departure and enroute constraints that are part of other traffic flow initiatives.

## Performance, Benefits and Metrics

| Performance/Benefits | Metrics |
|---|---|
| Departure throughput rates will increase and average taxi-out times will decrease due to better sequencing and load balancing at departure. | • Aggregate sum of inter-departure spacing times should be reduced for all flights in the presence of a queue. |
| Improved traffic flow and increased situational awareness will decrease the taxi-times. | • Taxi time from touchdown to gate for equipped flights compared to average for all flights same runway, concourse and time slot.<br>• Taxi times and departure throughput rates serve as proxies for improved traffic flow. |
| Improved communications and coordination will occur between system stakeholders. | • Number of aircraft in departure queue should decline and be more evenly balanced (considering departure path and user preference).<br>• Number, duration, and type of ATC communications within the surface area for a specific equipped flight during ground operations compared to average for all flights over same path (same time slot). [Communications focused on present position and intent should be reduced from the baseline.] |
| System efficiency will improve due to the improved planning data provided by the additional insight into active traffic back to the departure gate. | • Gate-to-Gate times for all aircraft arriving to or departing airports with improved queue insight and or SMS |

### Scope and Applicability

Availability of a robust surveillance data fusion capability is essential to increase system efficiency, provide common situational awareness and contribute to increased safety.

- Fusion of Automatic Dependent Surveillance – Broadcast (ADS-B) and multilateration position reporting with Airport Surface Detection Equipment (ASDE) primary radar in ASDE-X: ADS-B will provide accurate downlink of GPS-based position reports for equipped aircraft. Multilateration will provide position reports for all aircraft and vehicles having the appropriate equipage.tagged beacon transmitters.
- Demonstration of Multi-sensor Fusion of Surface Surveillance at Second Site (Louisville) will be conducted in September, 2002

Extension of the CDM methodology includes the provision of surface information via already established distribution architecture.

- Develop Surface Surveillance and Traffic Flow Management Data (CDM) Integration Plan in March 2002.
- Extension of information use across all service provider and user systems, as envisioned in the Concept of Operations, is dependent on establishment of standards for the exchange. Final Interface Standards for Surface Surveillance System will be published September 2002.

By September 2002, there should be a clear definition of Surface Management System (SMS) and its interfaces. The SMS concept is planned research from the National Aeronautics and Space Administration (NASA). The goal of the SMS research is to provide tools to increase efficiency by, for example; managing departure operations, runway queuing and load balancing. A Surface Management System Trial will be conducted at Memphis in December 2003.

- Several technologies will provide information upon which the SMS applications will be based to improve shared situational awareness and decision-making. SMS will provide decision-support tools to predict, plan, and advise surface aircraft movements and increase throughput and user flexibility using numerous data sources. SMS can provide controllers with a set of tools for tactical control and strategic planning of aircraft movements (arrivals and departures) on the surface while incorporating airline priorities.
- Free-Flight Phase One (FFP1) SMA provides transitional capabilities that will ultimately be incorporated in SMS. SMA provides estimated landing times for flights currently in the terminal area, based on information from the local Automated Radar Terminal System (ARTS). This provides users (dispatchers, ramp controllers and other airline personnel) improved information on arrival times to improve gate turnaround and avoid conflicts with gate management
- Independent analysis of benefits, costs and potential for use of SMS functionality across the NAS will support the business case decision for deployment. An independent Analysis of SMS Trial (to include benefits, costs, applicability to other sites) will be conducted in June 2004.
- A deployment decision for SMS will be made in December of 2004, with a target of an operational SMS in December of 2007 if a decision is made to move forward.
  NOTE: Technologies that will enhance situational awareness in the cockpit, such as Cockpit Display of Traffic Information (CDTI) are discussed elsewhere.

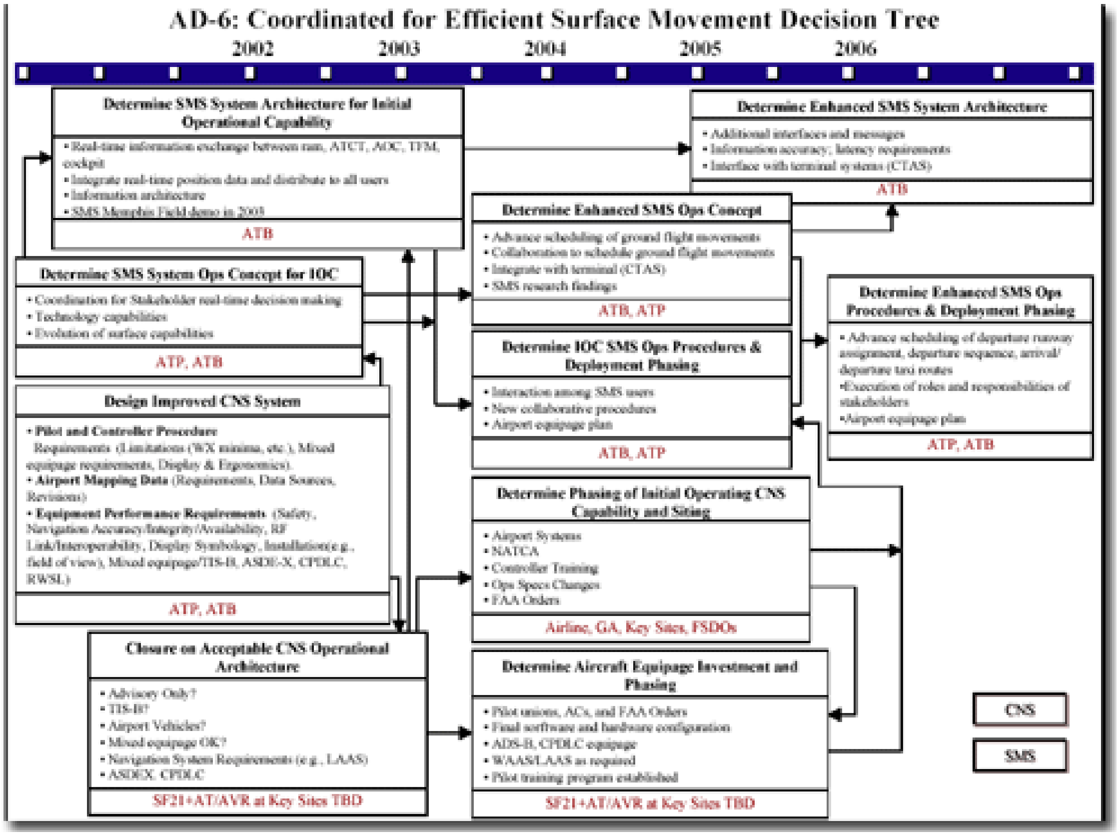
## Key Decisions

- Airport equipage of enabling technologies is critical to achieving the full benefit of SMS.
- Determination after analysis in 2003 Memphis trial on need for Local Area Augmentation System for surface surveillance accuracy requirements.
- Mandatory operation of transponders on the ground.

## Key Risks

- Defining a common SMS concept and requirements based on ongoing industry, FAA and NASA activities.
- Completing a NASA demonstration at Memphis in 2003.
- RTCA and international standards for surveillance data and avionics interfaces and protocols are on the critical path for scheduling.
- Deployment schedule for ASDE-X.
- Operational concept validation in Safe Flight 21.

## Decision Tree




View enlarged decision tree

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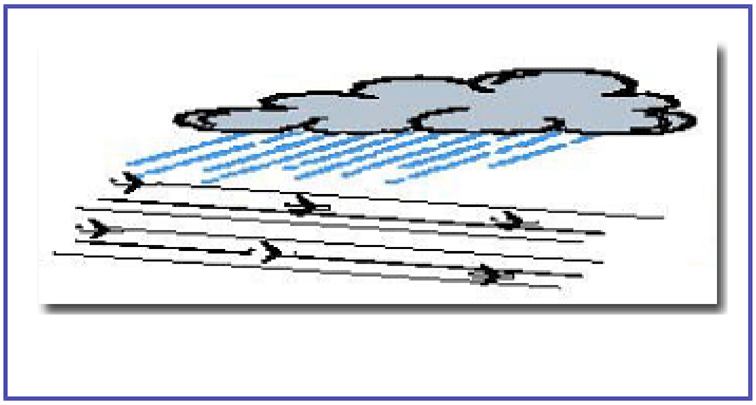
***Working Forums***

***Other Websites***
Relationship to the Architecture

# Operational Evolution Plan
# Airport Weather Conditions

## AW-1
## Maintain Runway Use in Reduced Visibility



The reduction in arrival and departure rates as weather deteriorates is primarily due to loss of optimal runway configurations. The solutions presented here address the cases where inadequate instrument approach capabilities are the cause. Applying technology and procedures will provide instrument approaches under a wider range of meteorological conditions.

Capability will continue to increase as satellite navigation and RNP services become universally available over the United States airspace with upgrades to support instrument approaches. Airport improvements in runways, markings, and airport lights are necessary to match this increasing capability for approaches in poor visibility.

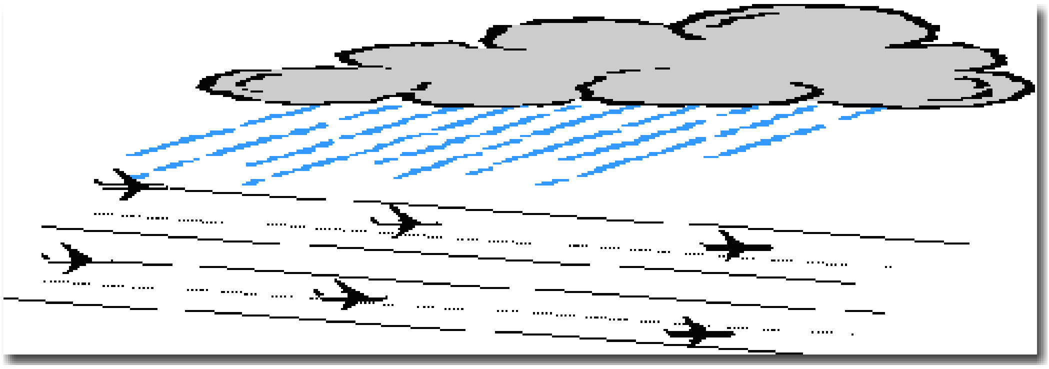
### Key Activities:

| | |
|---|---|
| FAA-Industry roadmap for RNP | 7/03 |
| Establish public approach criteria for RNP 0.3 | 9/03 |
| Implement RNP Parallel Approach Transition for one airport | 10/03 |
| User inventory of equipment | 10/03 |
| WAAS commissioning | 12/03 |
| LPV approaches | 12/03 |

### Smart Sheet:
### Version 5.0, December 2002

### AW-1: Maintain Runway Use in Reduced Visibility

**Optimize acceptance rates as weather deteriorates from Visual Meteorological Conditions (VMC) to Instrument Meteorological Conditions (IMC)**



## Background

There are three or more runway acceptance rates for each airport (based on benchmark analysis) – an optimum rate based on good weather conditions and two reduced rates based on marginal and adverse weather conditions, which may include poor visibility, unfavorable winds, or heavy precipitation.

Arrival rates deteriorate as weather changes from visual to instrument conditions. This premise is founded on the ability to provide visual separation between aircraft and for aircraft to achieve visual spacing for the runway. This standard acceptance rate reduction applies to single and/or parallel runway operations where the runways are separated by 4,300 feet or more. Two underlying factors that affect airport operations in periods of reduced visibility are:

1. Limitations of the instrument approach procedure(s) available at the airport; and
2. Inability to maximize runway acceptance when visual separation can no longer be applied.

## Ops Change

The goal is to achieve near optimum runway acceptance rates without regard for meteorological conditions. At runways without an existing instrument procedure, the publication of Area Navigation (RNAV)-based instrument approaches provides a new capability within the NAS. For those runways with existing procedures but non-optimum runway acceptance rates, other tools/operational implementations are required.

Special approach procedures apply enhanced surveillance capabilities and offsets to allow continued arrivals at higher than otherwise permitted capacities on closely spaced parallel runways. These procedures will be published for NAS runways that are capable of supporting them. Procedures for all scheduled air carrier airports will be completed by 2006.

Capability will continue to increase as satellite navigation services become universally available over the United States airspace. Complementary airport improvements in runways, markings, and airport lights are necessary to optimize this increasing capability for approaches in poor visibility.

Instrument approach procedures will be published for most runway ends capable of supporting them. Procedures for Part 139 airports will be completed by 2006; procedures for public airports with runways more than 5000 feet will be completed by 2010. Capability begins with GPS-based non-precision approaches and continually increases, as vertically guided approach services (e.g., LPV, LNAV/VNAV) become universally available over the US airspace in the mid-term. The next step is to provide improved service capable of Category I operations.

New approach procedures will increase in both availability and usage as widespread equipage and operations are enabled by the new navigation services. Further, the implementation of these procedures will provide for stabilized vertical descent path capability for numerous airports. These approaches support the CAST initiative and the aviation community's goals to reduce controlled flight into terrain incidents. Increased usage of GPS-based RNAV procedures will increase efficiency at many airspace-constrained airports.

Use of RNP permits greater flexibility and standardizes airspace performance requirements. By adopting RNP and leveraging existing and emerging cockpit capabilities, the FAA in collaboration with the aviation community will be able to improve airspace and procedures design, leading to increased capacity and improved efficiency.

The following sections address operational changes described:

- AW-1.1: *Continue arrival rates at higher level as weather deteriorates from VMC to IMC by increasing instrument approach services.*
- AW-1.2: *Introduce performance-based navigation requirements for all weather operations.*

### Benefits, Performance and Metrics

- Throughputs measured in arrivals per hour are sustained at a higher level as the ceiling and visibility decrease.
- Increased runway acceptance rate, in arrivals per hour, under IMC weather conditions.
- Increased IMC capacity and improved efficiency.

### AW-1.1 Continue arrival rates at higher level as weather deteriorates from VMC to IMC by increasing instrument approach services.

### Definition and Requirements for Instrument Approach Services

*Due to the complexity of the terms used in this paper, a set of definitions that provide a foundation for the discussion of the detailed operational changes are presented below.*

- *Non-precision approach (NPA) procedure* – An instrument approach procedure based on a lateral path and no vertical guide path.
- *Lateral Navigation/Vertical Navigation (LNAV/VNAV) procedure* – FAA Order 8260.3, Change 19 (RNAV Instrument Approach Procedures) includes a new minima line supporting instrument approaches with vertical guidance. LNAV/VNAV is the actual minimum line that denotes the provision of vertical guidance to a decision altitude (DA) in lieu of a minimum descent altitude (MDA) associated with non-precision approaches, typically based on barometric vertical navigation (VNAV).
- *LPV procedure* – The FAA is developing a new approach procedure that exploits the capabilities of the Wide Area Augmentation System (WAAS). LPV approaches are scheduled to be available by December of 2003. Like LNAV/VNAV, LPV includes a new minima line supporting instrument approaches with vertical guidance. Smaller TERPS protection areas will usually result in lower minima for LPV approaches. Initial studies have indicated that this type of approach can achieve minima of 250’ (height above threshold) and ¾ mile visibility. The addition of approach lights (see Category I below) may reduce visibility by ¼ mile.
- *Precision approach (PA) procedure* – An instrument approach procedure based on lateral path and vertical guidance.
- *Category I* – Category I operation is a precision instrument approach and landing with a decision altitude that is not lower than 200 feet (60 meters) above the threshold and with either a visibility of not less than ½ statute mile (800 meters), or a runway visual range of not less than 1,800 feet (550 meters).
- *Category II* - Category II operation is a precision instrument approach and landing with a decision height lower than 200 feet (60 meters), but not lower than 100 feet (30 meters), and with a runway visual range of not less than 1,200 feet (350 meters).
- *Category III* – Category III operation is a precision instrument approach and landing with a decision height lower than 100 feet (30 meters) or no decision height, and with a runway visual range less than 1,200 feet (350 meters).

### Scope and Applicability

### Near-Term:

- *New RNAV Procedures*. Standard Instrument Approach Procedures (SIAP's) for 576 airports, serving Part 139 airport operations, are in development and will be completed by 2009. As of August 2002, a total of 422 RNAV procedures have been published for 94 of the 576 airports. A total of 203 RNAV procedures have been designed for 33 of the 35 FAA's benchmark airports. A total of 180 RNAV procedures have been published for 27 of the benchmark airports. Procedures for the remainder of the benchmark airports (DCA, IAD, LGA, PDX, PHL, MDW, & TPA) are scheduled for publication prior to August 2003.
- *New precision approach services*. Precision approach capability will be established, improved, or sustained with ground based navigational aids (GBNA) within the NAS, using ILS and ancillary aids like approach lighting systems, runway visual range systems, distance measuring equipment, and visual glidepath indicator equipment.
- WAAS will be commissioned in 2003. The initial WAAS service will support LNAV/VNAV and LPV.

### Mid-Term:

- WAAS will expand to support LPV services throughout most of CONUS and Alaska by 2007.
- LAAS will provide precision approach services to Category I minima, and procedures will be developed and available for each LAAS installation scheduled for in the fourth quarter of FY06. The six initial sites are Houston, Juneau, Seattle, Chicago, Phoenix, and Memphis.
- RNAV Instrument Approach Procedures: 780 public airports with runways over 5,000 feet will receive RNAV procedures over the mid term extending into the long term, to be completed by 2010.

### Long-Term:

- Although approximately 1,100 NAS runway ends are equipped to support precision approach service, many of the approximately 3,000 non-precision approach runway ends in the NAS require airport infrastructure upgrades to support precision approach services. Visibility minimums of 1 mile can be supported with visual runway markings and low intensity runway lights (LIRL) for nighttime operations. Medium intensity runway lights (MIRL) and precision or non-precision runway markings are required to reduce visibility minima to ¾ mile. To establish ½ mile-visibility minimums the additional equipment requirements are precision runway markings, MIRLs for nighttime operations, and an approved approach lighting system.
- For most paved public airports, GPS/WAAS precision approaches will support the publication of minima to one mile visibility without requiring significant airport improvements in marking, lighting, and signage; however, only Part 139 and public airports with 5000' runways will have instrument approach procedures by 2010. Procedures for the remaining 1,300 public airports with paved runways (with runways less than 5,000 feet) will be completed after 2010.

### Key Decisions

- A decision will be made in 2005 to determine how to proceed with decommissioning some VOR facilities.
- A decision will be made in 2006 to determine which ILS facilities will be decommissioned beginning in 2010.
- A LAAS business case and research studies to develop CAT II and III LAAS system performance and design requirements will lead to a decision on how to proceed with LAAS in 2005. In addition, operational requirements for complex procedures will be determined, and the MOPS and MASPS developed, allowing a decision on the inclusion of complex procedures at the 6 initial LAAS sites.

### Key Risks

- Funding to develop, procure, install, and commission the above planned services.
- Geo-stationary satellite leases/acquisition risk for WAAS service.
-

- Timing and availability of WAAS/LAAS services.
- Voluntary user equipage and usage of WAAS/LAAS avionics/capability.
- Schedule for production version of WAAS/LAAS receiver.
- Environmental and airport infrastructure constraints.

## AW-1.2 Introduce performance-based navigation requirements for all weather operations.

### Scope and Applicability

The FAA has committed to develop and implement a plan to establish RNP airspace and procedures throughout the National Airspace System (NAS). As a result, we may achieve reduced terrain, obstacle and aircraft separation standards.

RNP airspace and procedures take advantage of aircraft's on-board navigation capabilities. These RNP procedures will result in increased levels of navigation accuracy and flight path predictability. This smart sheet addresses the approach phase of flight. Terminal and En Route phases are addressed in other smart sheets.

### Near-Term:

- FAA will develop and implement a plan to establish public use RNP airspace and procedures in United States domestic airspace. The FAA will work with industry to develop an FAA / Industry Roadmap for RNP by July 2003.
- FAA will develop and publish public approach design criteria for RNP in FY03.
- Determine the requirements for the removal of “DME/DME not authorized” on current RNAV approach plates by 1st Quarter FY03.
- *RNP Parallel Approach Transition* (RPAT) is the equivalent of conducting simultaneous instrument parallel approaches in IMC. The RNP Program will implement the RPAT operation at one airport in FY03. Initial candidates include Seattle and Cleveland.

### Mid-Term:

- FAA will publish approach procedures based on RNP 0.3 in FY05.
- There will be public RNP approaches for smaller RNP values and complex procedures, including the missed approach procedure. These procedures will require special aircrew and aircraft authorization. The FAA will continue implementing specials.

### Key Decisions

- Determine how to operationally manage DME/DME-based RNAV operations. The coverage and geometry of DMEs varies by procedure, and the required DME infrastructure to support a given operation depends upon the specific FMS. Several options include asking the operators to evaluate DME coverage and geometry to support specific procedures using their specific FMS, or establishing a minimum standard against which the FAA could accomplish this assessment. Flight inspection requirements must also be defined.
- Determine if RPAT can be used to conduct approach operations to runways spaced closer than 4300 feet without the need for high-speed radar (1 second update precision runway monitors).

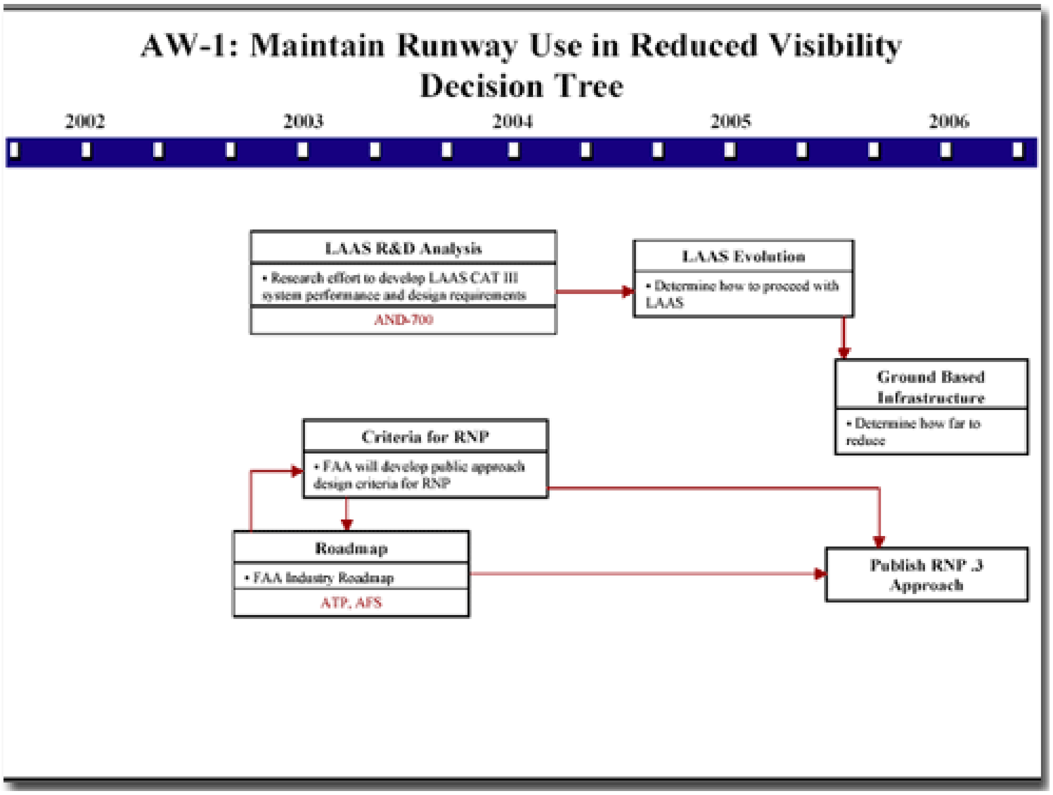
### Key Risks

- Consistent funding and resources.
- Industry equipage levels and consistency of avionics.
- Verification of DME/DME minimum standards.

DME/DME siting, decommissioning, and relocation.

User and service provider acceptance of RPAT.

### Decision Tree




[View enlarged decision tree](#)

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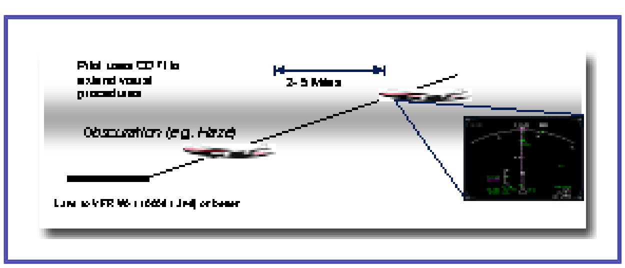
***Working Forums***

***Other Websites***
[Relationship to the Architecture](#)

## AW-2
## Space Closer to Visual Standards



Procedures for visual approaches require that the pilot visually acquire nearby aircraft as well as the runway. In marginal visibility conditions, pilots may have difficulty visually acquiring the runway or nearby aircraft, reducing arrival rates. Cockpit tools and displays can help to achieve higher throughput by enabling more rapid identification of aircraft, reducing the need for additional communications between the pilot and controller to advise on traffic. The cockpit display indicates target aircraft and trajectory information that the pilot can correlate to what is visible, providing faster target identification and helping the pilot maintain visual separation. This plan outlines two efforts. The first is an in service evaluation of the Enhanced See and Avoid application currently approved for use by UPS aircraft equipped with ADS-B operating at Louisville Standiford Airport (SDF). The second effort builds on this work by expanding the application to enable "visual" approaches.

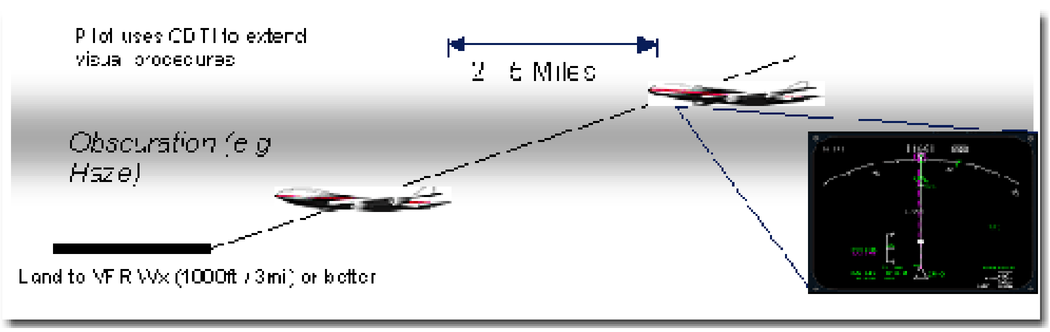
### Key Activities:

| | |
|---|---|
| Determination of whether to proceed to high fidelity simulation of continued visual approach | 5/03 |
| Publish Data collection plan for SDF | 10/03 |
| Begin Metrics collection of at SDF to identify benefits provided by ADS-B for Enhanced Visual Approaches | 11/03 |
| High Fidelity Simulations of continued visual approach | 1/04 |
| Determination of whether to proceed to flight testing of continued visual approach | 4/04 |

### Smart Sheet:
### Version 5.0, December 2002

### AW-2: Space Closer to Visual Standards

**Using cockpit tools and displays to achieve VFR throughput capacity in all weather conditions.**




### Background

The difference between Visual Flight Rules (VFR) and Instrument Flight Rules (IFR) capacities are significant – for example, at Dallas-Fort Worth International Airport, VFR arrival rate is 150/hour; this degrades to 95/hour when visual approaches cannot be performed. Typically, up to 30-40% of capacity is lost when weather criteria forces the airport to IFR operations.

Most airports have established weather minima below which visual approaches cannot be conducted, primarily due to the difficulty for the pilot or controller to visually acquire the runway or traffic in such weather. Currently, the requirement for visual approaches is ceiling 500 feet above minimum vectoring altitude and visibility 3 miles or greater. However, other environmental conditions such as haze, sunlight, smoke, and patchy clouds may effectively prohibit visual approaches at higher ceiling and visibility values.

The use of “Cockpit Display of Traffic Information (CDTI) Enhanced Flight Rules” (CEFR) may present the opportunity to use CDTI as an extension of the pilot’s eyes, thus enabling visual approach operations to continue in marginal VFR, and potentially down to instrument conditions. The research program summarized in this smart sheet provides an outline of the activities underway to develop an application demonstrating this capability.

### Ops Change Description

The operational change for this initiative is described in the following sections:

**AW-2.1**: There is no significant operational change in the initial application for use of the CDTI; however, it is expected to demonstrate efficiency benefits. The CDTI assists the pilot in visually acquiring and identifying an aircraft that has been referenced as traffic by Air Traffic Control (ATC), so the controller may clear the aircraft for a visual approach. This is a critical building block for future applications, such as the one described in AW-2.2.

**AW-2.2**: The CEFR concept would support Continued Visual Approach into marginal weather conditions. This would allow “visual-like” approaches to continue during periods when conditions do not permit continuous visual contact with traffic to follow. Conducting “Visual-like” Approaches under the CEFR concept would allow the approach to continue during periods of intermittent loss of visual contact. This application would be especially effective in restoring lost capacity at airports during conditions of darkness, haze, fog, thin cloud layers, marine layers, or other obscurations.

The initial application development is centered on the ability to perform this on a single-runway approach, as this would be the most basic form of this procedure. However, the application is being developed with the objective of performing this application with parallel runway configurations. The developers recognize that the majority of benefits will accrue with the enabling of parallel runway operations.

### Benefits, Performance and Metrics

- Reduction in en route delays resulting from better flows into airports.
- AW-2.1: Improved airport arrival throughput. Operational experience, and pilot and controller acceptance of Enhanced Visual Approach has a potential of 1 percent to 3 percent improvement in airport arrival rates at Louisville/Standiford Airport (SDF) with significant equipage.
- AW-2.2: Allow airports to continue visual arrival rates to lower actual weather conditions, and reduce the frequency and duration of ILS operations (individual airport throughput capacity varies, but is typically lower during ILS operations). Initial estimates of benefits show a potential annual savings of approximately 520,000 minutes of airborne delay if CEFR can be applied to MVA + 500 feet at the 31 benchmarked airports, and 1,090,000 minutes if CEFR can be used to basic VFR (1000' ceiling / 3 miles visibility). This assumes that CEFR will allow the airports to remain in their optimum configuration for arrivals/departures.

Additional Benefits: See *Safe Flight 21 Pre-Investment Analysis Cost Benefit Analysis Phase II Report*, 1 May 2001

### AW-2.1 Enhanced Visual Approach

### Scope and Applicability

The use of the CDTI assists the pilot in visually acquiring and identifying an aircraft that has been referenced as traffic by Air Traffic Control (ATC), so the controller may clear the aircraft for a visual approach. The CDTI enables quicker identification since the pilot will be able to correlate the target aircraft and trajectory information from the CDTI to the actual traffic as seen out-the-window. Another objective is to better enable the pilot to obtain and maintain visual separation once it is initially established.

With quicker identification of pertinent traffic, the need for additional traffic advisories by ATC or follow-on interactions between the pilot and controller should be reduced. No changes to FAA Order 7110.65 (Air Traffic Control) are required for this initial application.

In order to familiarize and give confidence in the equipment to flight crews of CDTI capabilities, this application will entail use of the CDTI during regular visual approach operations with no changes to the current procedures, visibility, or weather criteria. This will enable pilots to maintain better awareness of position and speed of traffic being followed.

This on board equipment has STC approval and will be evaluated in routine operations at SDF. Data collection and analysis to validate potential improvements will be implemented when user equipage reaches significant levels. UPS is equipping their aircraft, and expects to complete equipage by November 2003. A 12 to 24 month data collection and metrics effort will begin by the end of FY03.

Expansion of this capability will be dependent on a demonstrated benefit based on the metrics collection effort. Future implementation will be on an airport-by-airport basis based on equipage capability and potential benefits.

### Key Decisions

- UPS continued commitment to equip entire fleet with approved Level 1 avionics (107 aircraft by November 2003).
- UPS acceptance of demonstrated benefits and decision to keep their aircraft equipped with ADS-B (no later than December 2005).
- Site selection for further implementation based on collaborative decision between affected parties (e.g.: aircraft operator/pilots/FAA).

### Key Risks

- Feasibility of procedures in mixed equipage environment.
- Impact of mixed equipage on achievement of benefits.
- Equipment fielding schedule of UPS aircraft.
- Lack of demonstrated benefits from the metrics collection and analysis.

## AW-2.2 Continued Visual Approach

### Scope and Applicability

The context for application development is to keep the Continued Visual Approach as close operationally as possible to current Visual Approaches as defined in 7110.65, other than changing weather minimums in which they are authorized. This includes keeping the transfer of separation responsibility to the flight crew, as happens under current visual approaches. ATC techniques would remain the same in the Continued Visual Approach. The application design objectives for phraseology and other aspects of the application are similarly intended to be the same as under visual approach today. It is intended that this concept be used in conditions such as haze where visibility with aircraft to follow cannot be maintained, but all aircraft remain in VFR weather conditions (3 miles visibility and clear of clouds) as well as conditions resulting in short term periods of IMC such as penetration of a marine layer or scattered/broken cloud layer.

The exact application evolution will depend on the requirements determined to produce a CDTI with appropriate tools for the flight crew to ensure safe separation. A notional application evolution is as follows:

In the near-term, focus will be on the single-runway approach as well as parallel runway operations in marginal VMC only. In this level of the application, if the pilot has already established visual contact with traffic to follow while in-trail during a visual approach and that traffic has been correlated with CDTI symbology, then CDTI and appropriate tool set will permit the pilot/flight crew to maintain separation when visual contact is lost. Visual contact must be re-established in time to re-acquire the traffic and perform a stabilized approach to the runway. This will allow ATC to continue visual approach operations as long as VFR weather conditions exist at the airport. However, no change to ATC technique, procedure, or phraseology is anticipated or desired.

Progress is being made on research to resolve issues, driving toward obtaining certification and operational approvals.

- During FY02, the Safe Flight 21 Strategic Support Group (SSG) reached agreement on the high level concept for CEFR.
- Initial human-in-the-loop simulations indicated acceptance by ALPA and UPS pilot participants for separation responsibility based on use of the CDTI.

However, additional issues must be resolved before high fidelity simulations and flight testing can occur. For this reason, the SSG supports continuing to resolve these issues, for the specific purpose of driving toward a decision to proceed with high fidelity simulations in 3rd Quarter of FY03. Key factors that will influence a decision to proceed include:

- Flight standards and air traffic approval of the initial concept and procedures.
- Continued pilot and controller participation in the research and development of the application.

Based on a decision to move forward, draft detailed procedures (for AFM/7110.65) will be developed by 4th Quarter FY03. In conjunction with this, an Operational Safety Assessment and High Fidelity Simulations will be conducted in the first two quarters of FY04. Initial flight-testing is planned for the end of FY04.

Upon successful completion of the initial flight tests, Ops Spec / 7110.65 approval for initial CEFR implementation at key site (SDF) will occur no earlier than FY05 (individual aircraft fleet STCs). In-service evaluation and metrics collection at key site to validate the operational procedures and benefits will occur in the 12 to 24 months following initial implementation.

- Completion of the above activities will provide the basis for making the decision for implementation beyond the key site. Expansion will occur on airport-by-airport basis, with selection based on equipage capability.
- In the mid-term we will investigate adaptations, if necessary, to the procedure or equipment to perform the application during limited periods of IMC at runways that nominally support independent ILS operations (i.e. runways spaced > 4,300 feet).
- In the long-term, we will investigate use of the application during limited periods of IMC at runways that nominally require dependent ILS approaches (i.e. runway spacing between 3,000 feet and 4,300 feet). The final step will investigate use of the application at Closely Spaced Parallel Runways (i.e. runway spacings less than 3,000 feet). It is anticipated that adapting the application to parallel runways spaced at less than 4,300 feet under limited IMC will entail significantly more schedule risk than for the first two steps (i.e., for single runway and independent ILS parallel runways).

### Key Decisions

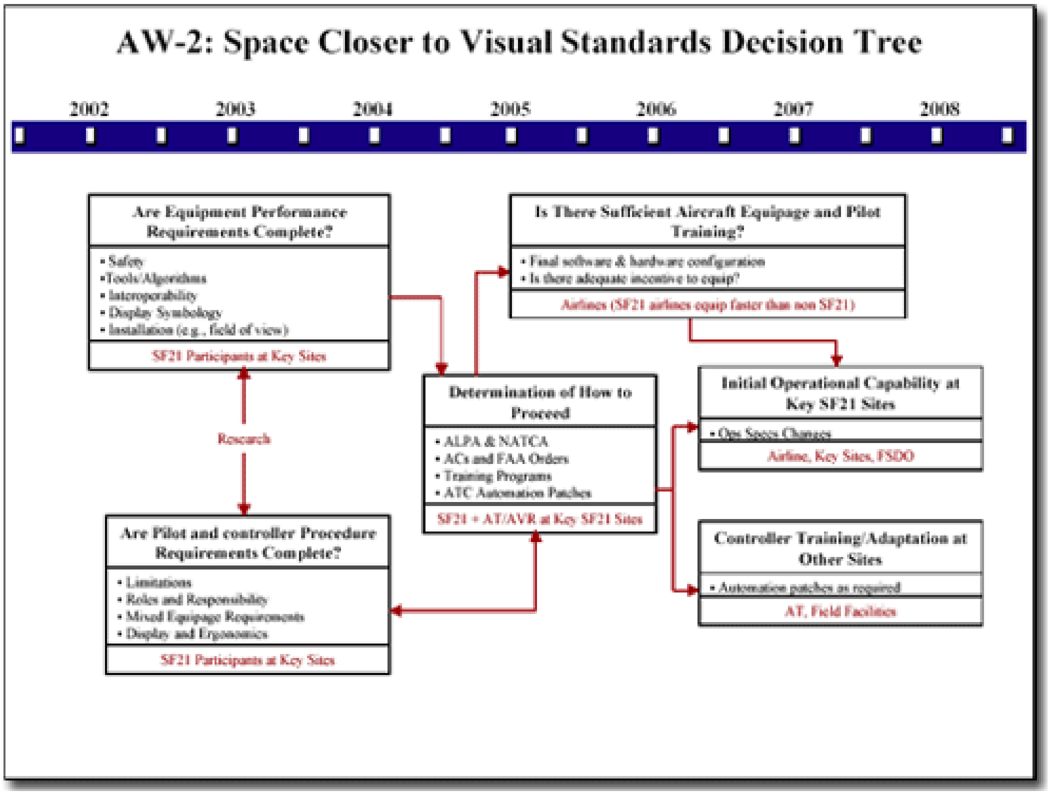
- Decision to proceed with the Continued Visual Approach development via high-fidelity simulation, as based on progress achieved in medium-fidelity human-in-the-loop testing. This decision will be made by the SSG and will be based on approval of major stakeholders (Air Traffic, Flight Standards, Aircraft Certification, ALPA, CAA, NATCA). Any additional time that may be required to adequately resolve issues beyond 3rd quarter FY03 must be specifically approved at that time, as such a decision will result in a slip of the milestones.
- Decision to proceed to Flight Testing, as based on results of high-fidelity simulation. Decision to proceed will be made by the SSG and will be based on approval of major stakeholders (Air Traffic, Flight Standards, Aircraft Certification, ALPA, CAA, NATCA). This decision is currently estimated for April 2004.
- Once high-fidelity flight simulations, flight testing, and Operational Safety Assessments have been completed, proceed with initial CEFR in-service evaluation at key site (Louisville/SDF).
- Site selection based on collaborative decision between affected parties (e.g.: aircraft operator/pilots/FAA).
- 

- Flight Standards / Air Traffic approval of initial concept / procedures.
- Aircraft Certification approval of equipment installation for this application (amended STCs as needed).
- Flight Standards District Office (FSDO) approval of airline Operations Specifications change.
- Satisfactory in-service evaluation.
- Air Traffic (AT) letter of authorization to allow extension of procedure to lower weather minimums at key site.
- AT approval to change of national 7110.65, to allow extension of procedure to lower weather minimums.

## Key Risks

- Acceptable resolution of separation responsibility issues.
- Business case for equipage.
- Feasibility of procedures in mixed equipage environment.
- Impact of mixed equipage on achievement of benefits.
- Pilot acceptance.
  - Acceptable workload in real-world conditions (e.g. full mission environment, varying winds, etc).
  - Adequate terrain protection when terrain not visible.
  - Adequate resolution of wake vortex avoidance issues.
  - Acceptable application toolset (e.g. map depictions, alerting and/or cueing requirements, etc).
  - Display location.
- Operator acceptance.
- Controller acceptance.
  - Acceptable workload.
  - Acceptable compatibility with current operations.
  - Ability to identify equipped aircraft.
- Integration of ADS-B into ARTS and STARS automation systems.
- Operational applicability.
  - Ability to operate at straight-in single runways.
- Ability to support various parallel runway operations (runways spaced > 4300’ apart, runways spaced between 2500 and 4300’, and runways < 2500’ apart).

## Decision Tree




View enlarged decision tree

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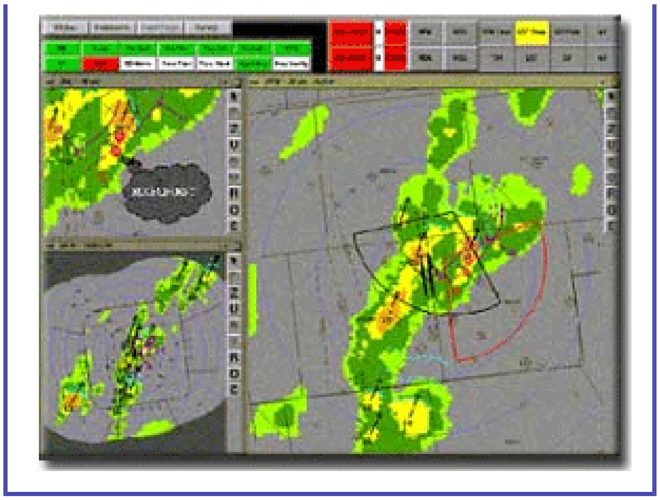
***Other Websites***

## AW-3:
## Reconfigure Airports Efficiently



Changes in wind direction over airport runways, and the onset or end of hazardous weather in the vicinity of the airport often require changes to airport arrival and departure configurations. Weather changes can result in a significant disruption of traffic flow if required configuration changes are not known in advance. With improved airport weather observations and predictions, traffic flow configurations can be proactively planned and coordinated among personnel at all of the involved air traffic control and airline operations facilities. The result will be smoother reconfigurations, optimization of traffic flow and reduced congestion at the airport. Prototypes are currently being used for this purpose at six airports. By the end of 2004 the enhanced reconfiguration capabilities will be available at 18 sites covering 31 airports.

### Key Activities:

| | |
|---|---|
| Full operational capability at Atlanta | Dec 2002 |
| Implementation at Kansan City, Houston, St Louis, Chicago, Potomac and New York | Sep 2003 |
| Implementation at Boston, Pittsburgh, Cincinnati, Detroit, Philadelphia, Indianapolis, Denver and Cleveland | Sep 2004 |

### Smart Sheet:
### Version 5.0, December 2002

### AW-3: Reconfigure Airports Efficiently

**Timely planning and coordination of configuration changes during changing weather conditions.**

### Background

Significant changes in wind direction over airport runways, or the onset/end of hazardous weather in the airport environment, often require changes to the airport departure and arrival configurations. The onset of hazardous weather can result in major disruptions of traffic flow unless there is advance knowledge of configuration change requirements. With this understanding, the FAA is deploying systems that will assist users in making better informed decisions, thus minimizing disruption to traffic flow during weather events while maintaining the safety of the system.

### Operational Change Description

Accurate information regarding the location and severity of hazardous weather or changes in wind direction will enable optimal use of airspace, runways, and terminal facilities during the weather event. Delays will be reduced; operational efficiency and capacity will increase. The Integrated Terminal Weather System (ITWS) is a weather information platform that provides improved weather predictions and observations to traffic management personnel. Traffic managers will be able to use that information to proactively plan traffic flow reconfiguration and to coordinate with personnel in the TRACON, ARTCC, ATCSCC and dispatchers in AOCs. Current plans call for ITWS to be located at 34 sites providing coverage for 47 airports. Coverage will include high traffic airports, particularly those where thunderstorms occur frequently, thus maximizing delay reduction benefits throughout the NAS.

No formal changes to operational rules and procedures are anticipated. However, overall improvement in coordination and ATC efficiency is expected as the ITWS provides a single, reliable source of significant real-time weather information to users.

ITWS prototype operations at NY airports (EWR, LGA, JFK, and TEB) are addressing adjacent airport coordination; several other ITWS sites will also include multiple airport environments. Common situational awareness of weather scenarios—especially, those affecting traffic routes and potential reconfigurations—among decision makers at adjacent airports is significantly improved as ITWS is deployed. Procedures and coordination already in use at these sites will be enhanced by the timelier and more accurate information provided by ITWS.

The AW-3 Solution Set will consist of the following:

**AW-3.1**: Efficient Airport Reconfiguration in Response to Hazardous Weather
**AW-3.2**: Efficient Airport Reconfiguration in Response to Wind Changes

### Benefit, Performance, Metrics

Improved situational awareness with regard to weather promotes greater efficiency in the management of terminal air traffic activities; the result is a decrease in the number and duration of delays. Extensive experience with four prototypes over the past eight years have enabled users to measure direct operational benefits:

- Departure and Arrival Delay
  - Increased number of arrivals
  - Reduction in number of departure delays
  - Reduction in downstream delays
- Ground Stop Management
  - Fewer unnecessary ground stops
  - Shorter ground stops
- Diversions
  - Fewer diversions due to landing more arrivals
  - Anticipate diversions sooner

The majority of ITWS benefits fall into the category of delay reduction. However, microburst prediction, lightning warning, and indications of severe storm location and intensity contribute to improved safety, as well.

### AW-3.1 Efficient Airport Reconfiguration in Response to Adverse Weather

### Scope and Applicability

ITWS will provide accurate graphical depictions of current and predicted location and movement of hazardous weather that will affect airport acceptance rates. TMU specialists, supervisors, and dispatchers will be able to anticipate—rather than just react to—hazardous weather. Coordinating the movement of traffic through alternate arrival/departure routes will result in overall increases in capacity and reduction of delays.

The procedural improvements that rely on ITWS include:

-

- Runway Management
  - Recognize that a runway will remain open
  - Better timing of runway shifts due to storms
  - Better anticipation of runway operation restart
- Arrival Transition Area (ATA) Management
  - Earlier shifts to alternative ATA
  - Shift arrivals to more direct ATA sooner
- Departure Transition Area (DTA) Management
  - Anticipate DTA closure sooner
  - Balance traffic through DTAs during storm passage

ITWS capability has been demonstrated extensively. Prototypes have been in use at selected sites since 1994, including EWR, LGA, JFK, DFW, MEM, and MCO. Additional systems have been installed for operational testing at the Kansas City and Houston airports. The first production system achieved Initial Operational Capability (IOC) in Atlanta in July 2002 and assessment of operational benefits is continuing at that location. Deployment plans call for 6 new sites in 2003 and 8 more in 2004.

Initial deployment of ITWS will integrate the information from weather sensors (TDWR, NEXRAD, LLWAS, ASR-9) in the airport terminal environment. Products include:

- Runway specific warnings up to 2 minutes prior to occurrence of a hazardous microburst.
- Improved determination of gust front location and intensity and the forecasts (10- and 20-minutes) of future gust front positions.
- The location, extent, and intensity of precipitation, along with the current and 10- and 20-minute extrapolated position, extent, speed, and direction of individual storms.
- Improved anticipation of wind shear impacts

These products will be available to flight crews and air traffic planners, and will enable potentially impacted airports to implement safe alternative traffic patterns and achieve higher capacity levels throughout the impact period. The products will be provided to the ATCSCC and external users, including airlines, NWS, airport/port authorities, and others—through Volpe and intranet access.

### Milestones/Key Dates

- Full Operational Capability at Atlanta: December 2002
- FY03: Kansas City, Houston, St. Louis, Chicago, Potomac, New York
- FY04: Boston, Pittsburgh, Cincinnati, Detroit, Philadelphia, Indianapolis, Denver, Cleveland

### Key Decisions

- Agreement among internal and external (e.g., airlines, NWS) users that existing procedures for airport reconfiguration are sufficient to accommodate planned ITWS deployment.
- FAA decision on revised cost and schedule baseline.

### Key Risks

- Maintaining schedule

## AW-3.2 Efficient Airport Reconfiguration in Response to Wind Changes

### Scope and Applicability

Changes in wind direction at NAS pacing airports often cause air traffic delays. When the wind changes, air traffic controllers have to change the direction from which aircraft land and take off, that is, “turn the airport around.” Advance knowledge of wind shift changes can save the 15 to 20 minutes needed to reposition aircraft.

ITWS capability can be enhanced to track and display wind shift changes well beyond the immediate terminal area. An algorithm would assimilate and process surface wind data from various sensors (i.e., Automated Surface Observing System (ASOS)/Automated Weather Observing System (AWOS), Low Level Windshear Alert System (LLWAS), radars (Terminal Doppler Weather Radar (TDWR) or Airport Surveillance Radar (ASR)-9)), taking measurements from between 50 to 100 nm from the airport in order to detect and track wind shift changes as they near the airport. Such a detection and “nowcast” (very short-term forecast) capability will provide traffic management specialists with ample planning time to sequence and position arriving aircraft into favorable approach corridors, both before and after the wind shift occurs at the airport. Ground controllers will be able to do the same with departing aircraft.

This is concurrent with the aforementioned system deployment.

### Milestones/Key Dates

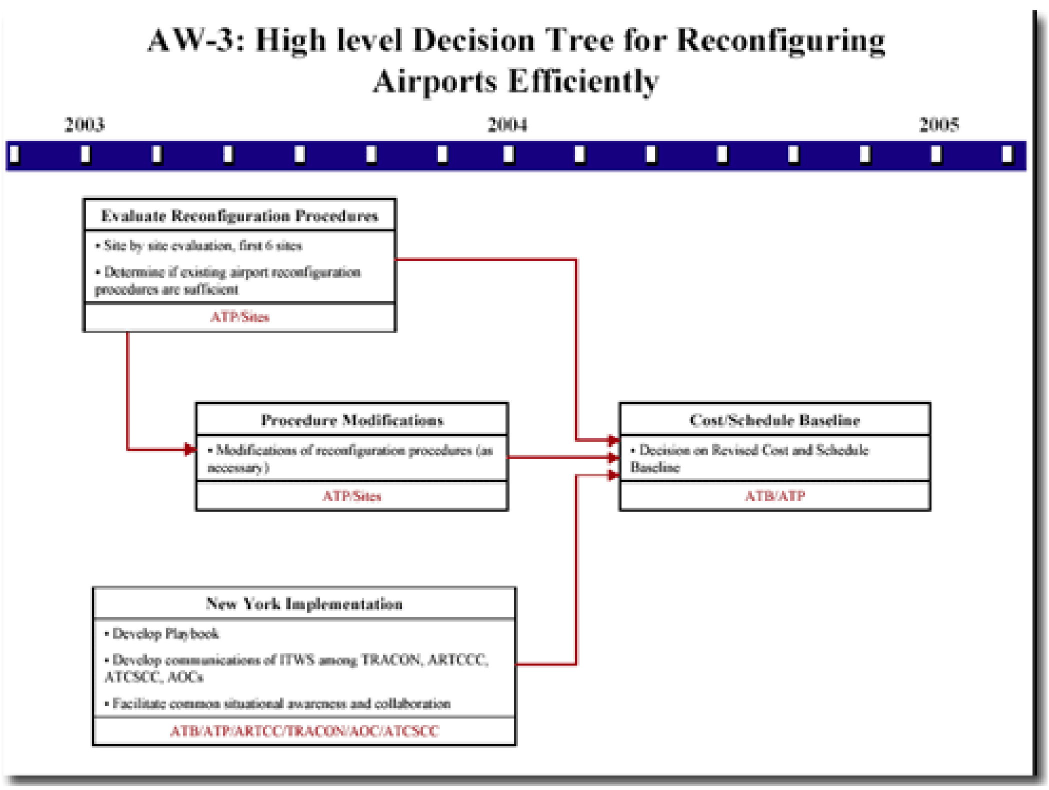
- Full Operational Capability at Atlanta: December 2002
- FY03: Kansas City, Houston, St. Louis, Chicago, Potomac, New York
- FY04: Boston, Pittsburgh, Cincinnati, Detroit, Philadelphia, Indianapolis, Denver, Cleveland

### Key Decisions

- Define the solution for the New York area in terms of ITWS & CIWS, prototypes or production models

### Key Risks

### Decision Tree




View enlarged decision tree

### Responsible Team

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***Working Forums***

***Other Websites***
[Relationship to the Architecture]

## AW-4
## Enhanced All-Weather Surface Operations

During low visibility through zero-visibility surface operations, the pilot and controller both lose the visual references that are key components to situational awareness that supports safe and efficient surface movement in good visibility conditions. As a result, the surface operations are slowed and efficiency is greatly reduced. Prototype demonstrations of cockpit surface movement maps have shown promise in improving crew situational awareness in low visibility. These tools supplement the pilot's out-the-window assessment of aircraft position, direction and speed. When coupled with positive identification of other surface traffic, procedures can be changed to direct one aircraft to follow another without visual references outside the cockpit. These changes may enhance pilot confidence and efficiency in moving about the airport surface. The key to success for this initiative as an OEP capacity enhancement is the ability to go beyond improvement in situational awareness to improved efficiency in surface movement.

### Key Activities:

| | |
|---|---|
| UPS Equipage Louisville | 2002 |
| UPS Supplemental Type Certification | 2002 |
| Surface Operational Safety Assessment | 2002 |
| Airport Surface Maps to top 64 Airports | 2003 |
| | |

| | |
|---|---|
| UPS Crew coordination changes at Louisville | 2003 |
| AT procedural changes at Louisville | 2004 |
| Measurement of actual performance improvements at SDF | 2004 |

**Smart Sheet:**
**Version 5.0, December 2002**

## AW-4: Enhanced All-Weather Surface Operations

**Improved surface navigation and traffic situational awareness for pilot**

### Background

In today's environment, the pilot uses visual references and navigation aids and air traffic controller communications to determine aircraft position on the airport surface, and uses visual references to maintain separation from aircraft and other vehicles. The controller also uses visual references to manage traffic with surveillance and automation providing advisory information. While the air traffic controller is responsible for separation on the runway, the pilot is responsible for separation while taxiing to the runway or gate, regardless of airport visibility. In today's environment, taxi workload is normally divided between Pilot Flying (PF) and Pilot Not Flying (PNF). PF typically steers the aircraft using visual techniques. The PNF typically backs up the pilot by monitoring progressive taxiing with paper maps, and handles communication with ATC. During low visibility through zero-visibility, the reduced ability to see signage can lead to confusion in navigating the aircraft on the surface. The inability of the pilot and the controller to "see" the picture in reduced visibility leads to greatly reduced operations on the surface. It is also important to note that regardless of the meteorological conditions, improvements in the cockpit situational awareness will have an impact in the area of safety as well as capacity.

### Operations Change Description

The ultimate goal, as expressed in the NAS Concept of Operations, is to have Visual Meteorological Conditions (VMC) like operations in zero-visibility conditions. There are research activities in place at NASA and other facilities to investigate how this may ultimately be achieved. There are also incremental steps that lead to that goal.

- One such activity is the research, development and implementation of multi-function displays on the flight deck with moving map applications. Flight deck simulation studies performed by NASA over a period of years documented significant reductions in taxi times of 25% to 19% during periods of low/moderate visibility, when pilots used flight deck Surface Moving Map (SMM) displays as an aid. These findings were corroborated by flight tests conducted by the Safe Flight-21 (SF-21) program at Louisville, KY, in October 2000.

Cockpit SMM's provide crews with robust surface navigation information, thus increasing pilot awareness of the aircraft's position on the airport surface and other traffic operating in proximity to the aircraft. These SMM's help the pilot guide aircraft along the surface in accordance with ATC instructions, or in accordance with a self-generated taxi plan in the case of non-towered airports. Initially, these tools will supplement the pilot's out-the-window visual assessment of the aircraft's position on the surface, its direction, and speed. Cockpit and Air Traffic procedural changes will allow ATC to direct one aircraft to follow another aircraft without visual reference outside the cockpit. Crewmembers will make use of the display to monitor progressive taxiing, and to positively identify those aircraft they were directed to follow by ATC instruction. The increased knowledge of exact aircraft placement relative to the airport has been demonstrated to decrease crew workload and improve taxi performance.

As the accuracy of the positions of proximal traffic along with call sign information improves, crews are able to correlate traffic observed on the display with clearances and, when available, outside visual information. With this enhanced understanding of traffic, crews are able to perform their taxi clearance and navigate to departure, or gate, in even zero-visibility conditions.

### Benefits, Performance and Metrics

- Improved taxi times at night and under other reduced visibility conditions.
- Average gate to gate times should decrease.
- Reduced fuel burn during taxi.
- Maintaining VMC capacity in Instrument Meteorological Conditions (IMC) visibility will reduce the amount of delay and the number of diversions and cancellations.
- Improved situational awareness in the cockpit.

### Scope and Applicability

In today’s environment, ATC formulates overall taxi sequence plans, and communicates these plans as a set of instructions to both aircraft and vehicles through radio communications. The biggest challenge for ATC is making sure that the aircraft understands the communications. In executing the taxi plan, ATC uses many techniques such as identification of “company traffic” or other descriptors to ensure that pilots understand their place in the “big picture.”

Moving maps should provide the capability to receive and display the same surveillance data to tower controllers, pilots, ramp controllers, and others that are involved with surface operations. These maps are proposed for 59 Airport Surface Detection Equipment -X (ASDE-X) sites.

- FAA SMM Enabling Activities:
  o FAA-approved Concept of Operation – March 2002

  FAA to complete all Key Site activities at Louisville Airport (SDF), including Surface Operational Safety Assessment – November 2002; the in-service evaluation and metrics collection Sep 2001- Sep 2005
  o Deliver airport surface map database for top 65 airports – February 2003

- Airline Certification and Installation Plans:

  o United Parcel Service (UPS) Supplemental Type Certification for SMM in Boeing 757 – October 2002

Benefits measurements have, to date, only been simulated. It is anticipated that equipage of the UPS fleet with SMM’s at their SDF Hub facility will provide the first opportunity to measure actual performance improvements. If the bottleneck is at the departure end of the runway, increased throughput on the surface will not result in significant capacity benefits.

It is also important to note that an early application of this technology will be the introduction of the “moving map” as a tool to enhance situational awareness in all meteorological conditions. This opportunity will enhance the safety of the operation on the surface, while also benefiting capacity and efficiency at the airport during those periods where confusion may exist between the controllers and pilots.

### Key Decisions

- Crew coordination changes will be needed to make the most of new SMM information in the cockpit.
- Until very advanced operations are approved, the surface applications should be in support of the visual maneuvering of the aircraft and should only be used in an advisory role.
- SF-21 is currently anticipating UPS to commit to installing SMM’s, starting with their 757 fleet in October 2002.
- Beyond UPS, all airlines will have to commit to equipping their fleet with SMM’s.
- Procedures for low visibility operations using surveillance and displays as position source for both

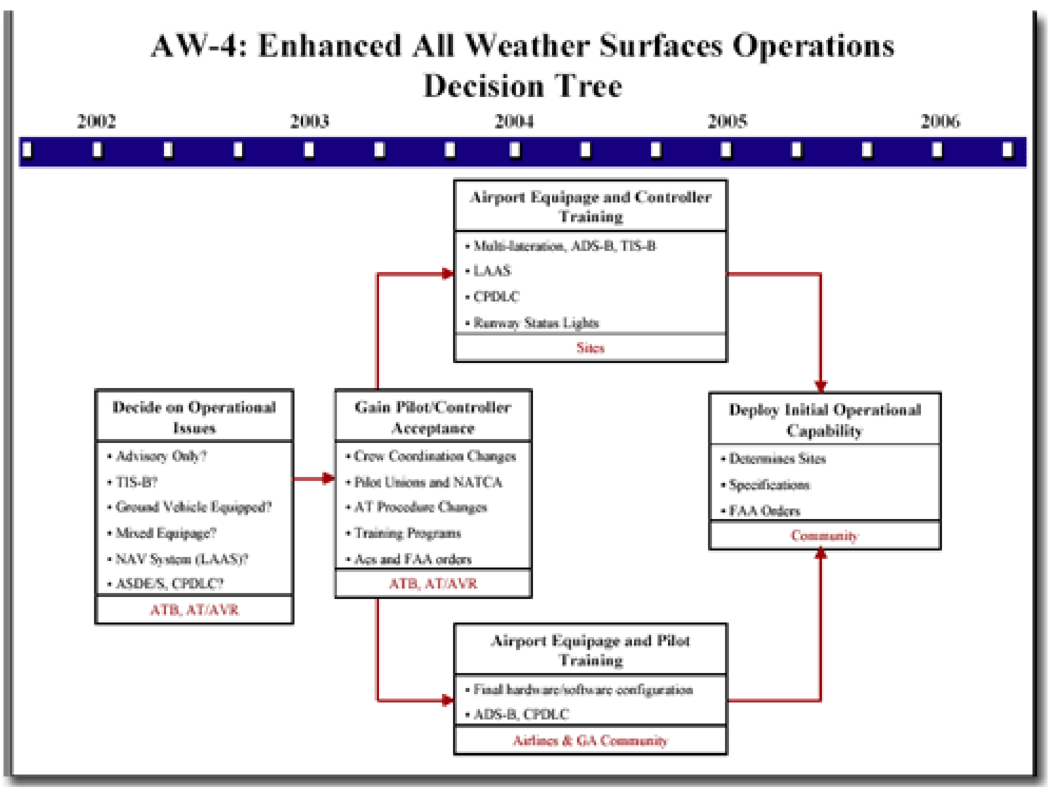
controller and pilot.

- Develop certification criteria for use of surveillance systems and displays for separation procedures on the surface including runway operations.

### Key Risks

- Operations fall back to the current mode when position sensors (e.g., GPS-based signals) are not providing adequate accuracy or integrity (depending on the complexity of surface application) or if there is a problem with onboard avionics.
- Failure on the part of UPS to start equipping its fleet with SMM's will significantly impact our ability to implement this capability or measure anticipated benefits.
- Contingent on continued funding, SF-21 must continue maturing the technology and deliver several critical items including:
    - Resolution of cockpit human factors/workload issues (heads-down time, surface clutter, day/night visibility, and display scale, heads up/down).
    - Development of "Call Sign" Procedure for initial use at SDF.
    - Development of Map Data Base for the top 60 airports.
    - Operational Safety Assessment to support certification.
- Managing change: acceptance of new procedures based on new technologies, from both the ATC and aircraft operators' perspectives.
- Feasibility of procedures in mixed equipage environment.
- Beyond the initial applicant, expanding the use of SMM for use at other airports.

### Decision Tree




[View enlarged decision tree]

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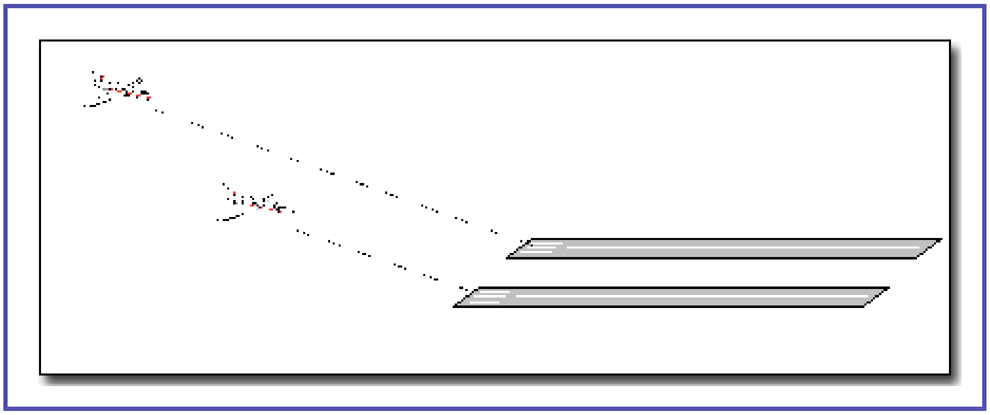
Relationship to the Architecture

## AW-5
## Maintain Optimum Runway Use at Airports with Closely Spaced Parallel Runways



When simultaneous operations based on visual procedures must be discontinued, the operation must be conducted as if the airport had only a single runway for arrivals. All arrivals must be sequenced by air traffic controllers into a single stream and the reduced arrival rate is practically 50 percent of the optimum rate.

Additional measures providing an equivalent level of safety for simultaneous operations to closely spaced parallel runways as compared to simultaneous operations to widely spaced runways, will allow airports to maintain an optimum runway use for longer periods of time as weather deteriorates.

### Key Activities:

| | |
|---|---|
| Analysis plans for wake studies | 2/03 |
| Test plans and milestones for wake studies | 3/03 |
| Resume PRM operations at MSP | FY03Q2 |
| Determine feasibility of along track separation | 9/03 |
| Complete initial study on along track Separation | 12/03 |

**Smart Sheet:**
**Version 5.0, December 2002**

### AW-5: Maintain Optimum Runway Use at Airports with Closely Spaced Parallel Runways

**Optimize Closely Spaced Parallel Runway Operations**

## Background

The FAA developed capacity benchmarks for the nation's busiest airports. There are three rates for each airport – an optimum rate based on good weather conditions and two reduced rates based on marginal weather and adverse weather conditions, which may include poor visibility, unfavorable winds, or heavy precipitation.

Of the top 35 delayed airports in the NAS, 16 have closely spaced parallel runways (parallel runways with centerlines separated by less than 4,300 feet) and 5 of the 8 pacer airports have closely spaced parallel runways. During visual meteorological conditions, simultaneous departures and arrivals may be conducted at those airports based on the use of visual procedures. Airport operations are relatively efficient and delays can be minimized. As weather conditions deteriorate, simultaneous departures and arrivals based on visual procedures must be discontinued and standard instrument flight rules (IFR) aircraft separation must be provided.

Current FAA IFR separation standards and procedures stipulate that with conventional terminal radars, with an update rate of approximately 4.8 seconds, simultaneous independent approaches can be conducted to parallel runways with centerlines separated by at least 4,300 feet. Standard in-trail separation is provided between aircraft on the same approach course. At locations where the parallel runways are less than 4,300 feet but at least 2,500 feet apart, parallel dependent (staggered) approaches may be conducted. Parallel dependent approaches do not provide the optimum rate that would be available if simultaneous independent parallel approaches could be conducted. At airports with closely spaced parallel runways, the ability to conduct simultaneous independent approaches could support a potential 25 percent increase in airport arrival rates over parallel dependent approach arrival rates. When the runways are separated by less than 2,500 feet apart, parallel dependent approaches cannot be conducted at all. When simultaneous operations based on visual procedures must be discontinued, the operation must be conducted as if the airport had only a single runway for arrivals. All arrivals must be sequenced by air traffic controllers into a single stream and the reduced arrival rate is practically 50 percent of the optimum rate.

## Ops Change Description

The large variations in arrival acceptance rates at major airports resulting from poor visibility or low cloud ceilings have a significant impact on system delays and create problems for air carriers to maintain scheduling integrity. With respect to departures from parallel runways separated by less than 2,500 feet, the ability to support the optimum rate in all weather conditions and for all aircraft types when visual procedures cannot be utilized would have a significant impact on the efficiency of airport operations.

FAA study and analysis helps determine whether additional measures must be implemented to provide for an equivalent level of safety for simultaneous operations to closely spaced parallel runways as compared to simultaneous operations to widely spaced runways. Such measures may include the use of high update rate surveillance technology to monitor aircraft on final approach, special pilot and controller training, or wake turbulence research to identify alternative wake mitigation measures for parallel runways separated by less than 2,500 feet.

Recent experience has demonstrated that when additional requirements are implemented to support closely spaced parallel runway operations, user and service provider participation is critical to ensure that necessary training is accomplished or additional equipment is installed and operated. A very high level of user and service provider participation rate is necessary to support the overall efficiency of the closely spaced runway operation. The closer that the closely spaced operation resembles current procedures and operating practices, the greater the prospects for full participation and the sooner that efficiency benefits can be realized.

The following sections address operational changes described:

- **AW-5.1:** Implement Enhanced Surveillance Capabilities and Procedures to Support Simultaneous Approaches to Closely Spaced Parallel Runways in Deteriorating Weather Conditions.
- **AW-5.2:** Wake Turbulence Research and Development Effort to Enhance Operations for Closely Spaced Parallel Runways.
- **AW-5.3:** Research and Development of the Along Track Separation Concept to Improve Airport Arrival Capabilities in Instrument Meteorological Conditions.

### Benefits, Performance and Metrics

- Runway operations per hour are sustained at a higher level during inclement weather.

## AW-5.1 Implement Enhanced Surveillance Capabilities and Procedures to Support Simultaneous Approaches to Closely Spaced Parallel Runways

### Scope and Applicability

The intended benefits of PRM include increased throughput, reduced delays, and improved fuel savings. The FAA selected Kennedy, Minneapolis, St. Louis, Atlanta, and Philadelphia as candidate airports. The Administrator subsequently agreed to support additional sites at San Francisco and Cleveland with a commitment to accommodate Atlanta at the appropriate time.

### Near-Term:

- National criteria and guidance for constructing and operating SOIA to parallel runways separated by at least 750 feet apart and less than 3,000 feet apart at FAA-designated airports completed. Associated air traffic document changes are being finalized.
- Installation of PRM at San Francisco and Kennedy.
- Implementation of PRM-SOIA operations at St. Louis and San Francisco with associated wake safety assessments.

### Mid-Term:

- Further site-specific SOIA procedure development as new PRM sites are approved and utilized.
- Address enhanced surveillance capability at Detroit and Atlanta.

### Long-Term:

- Further site-specific SOIA procedure development as new PRM sites are identified and approved.

### Key Decisions

- Finalization of PRM/SOIA procedures.
    - ATC procedures.
    - PRM pilot training requirements.
- Obtain necessary MOUs.
- Enhanced surveillance technology decision for sites beyond the near term.

### Key Risks

- Efficiency benefits may not be realized unless users and service providers fully support and accept PRM-SOIA procedures.
- PRM-SOIA procedures are dependent on specific runway configuration and associated equipment siting requirements. It may not be possible or beneficial to conduct PRM-SOIA at every airport.
- Funding PRM Supportability Action Plan.
- Unless participation issue is resolved, there may be no benefit at Kennedy.
- If an enhanced surveillance capability is not available, the benefits of a new runway may not be realized.

## AW-5.2 Wake Turbulence Research and Development Effort to Enhance Operations for Closely Spaced Parallel Runways

### Background

In accordance with current FAA wake turbulence standards, when closely spaced parallel runways are separated by less than 2,500 feet, arrival and departure operations must be conducted as if the airport had only a single runway. As a result, the operational efficiency of the airport is reduced to a rate that is significantly lower than the optimum rate. The reduced runway operations rates at major airports have a significant impact on system delays and create problems for air carriers to maintain scheduling integrity.

A reduction in the wake turbulence standard for Closely Spaced Parallel Runways to a lesser runway separation, along with certification of radar separation standards for operations at the lesser runway separation would enhance the efficiency of operations at many airports in the NAS.

### Scope and Applicability

This effort will identify runway separation criteria for wake independent operations on closely spaced parallel runways addressing all operational applications including dual operations with small aircraft operating independently from other small aircraft; dual operations with a large aircraft on one runway and a large or small aircraft on another; and dual operations with heavy aircraft on one runway and a heavy, large or small aircraft on the parallel runway. In addition, this effort will validate the revised CSPR wake turbulence criteria and validate reductions in the associated radar separation criteria to support arrival and departure operations to or from runways separated by less than 2500 feet. This effort is designed to minimize requirements for new equipment, training, or procedures to maximize pilot and controller acceptance and participation and to maximize the potential benefits to be derived.

This effort may be applicable to 11 of the 35 OEP airports, after validation at one or more of these sites.

### Near-Term:

- Identification of revised CSPR wake turbulence runway centerline separation requirements.
- Development of validation criteria in partnership with stakeholders.
- Implementation of initial CSPR validation effort at selected site(s).
- Development of efficiency benefits metrics.
- Collision risk assessment of 1.5 nm staggered approach to runways separated by less than 2500 feet.

### Mid-Term:

- Implementation of revised separation standards based on validated CSPR wake turbulence requirements.
- Incorporation of new procedures/standards, as appropriate, into FAA directives.

### Long-Term:

- Planning and construction of new runways enabled by the new CSPR wake separation standards.
- Continued wake research to address additional wake capacity constraints.

### Key Decisions

- Identification, prioritization, and support for resources for FAA analyses to develop and validate the wake turbulence standards and the new separation standards for CSPR.
- Sites selected for validation.
-

Validation criteria.

### Key Risks

- Pilot and controller participation and acceptance.
- Limited applicability of new standards.

### AW-5.3 Research and Development of the Along Track Separation Concept to Improve Airport Arrival Capabilities in Reduced Visibility Conditions

### Scope and Applicability

The FAA has received several delay reduction/capacity enhancement proposals that are identified as, or are associated with the Along Track Separation (ATS) concept. Many concepts propose to take advantage of site-specific runway configurations or the availability of on-site equipment such as a high update rate surveillance system.

While further research may identify the need for additional measures to provide for an acceptable level of safety, the FAA believes that the greatest benefit derived from a research and development (R&D) effort of the ATS concept would be to base the concept on current, conventional systems and procedures to minimize requirements for new or additional equipment, training familiarization, and other system integration impacts thereby maximizing the potential participation by pilots and controllers.

The initial research and development will focus on a generic concept with the broadest possible application with a minimum of additional requirements. Initial research and development effort will focus on those elements that all of the stakeholders' proposals have in common. Those elements are:

1. Dual straight-in ILS (or a straight-in ILS and an offset, by no more than 3 degrees, ILS) approaches to parallel runways with centerlines separated by less than 2,500 feet.

2. Application of parallel dependent separation criteria (1.5 nm diagonal spacing) between aircraft on the adjacent approaches.

3. Application of either standard in-trail wake turbulence separation criteria between aircraft on adjacent approach courses in lieu of lateral approach course separation, or an as-of-yet-to-be-determined wake mitigation procedure that provides for an equivalent level of safety.

**Near-Term**

- Determine feasibility of along track separation concept.
- Completion of initial study.
- Develop and validate approach procedures using collision risk and wake assessments.

### Key Decisions

- Identify the minimum operational and procedural requirements to support the safe application of ATS to Category I, II, and III minima for a straight-in ILS approach; and 200-foot minima or less for an offset ILS or an LDA with glideslope offset by up to 3 degrees.
- Operational and procedural requirements should, to the maximum extent practicable be based on existing procedures and phraseology as specified in FAA Order 7110.65 and should not require changes to approach plate design or nomenclature.
- Identification of minimum separation required between aircraft on adjacent approach courses including applicable wake vortex mitigation requirements
- Identification of minimum runway centerline spacing required to support along track separation. The centerline spacing criteria must be applicable to all parallel runway configurations and take into

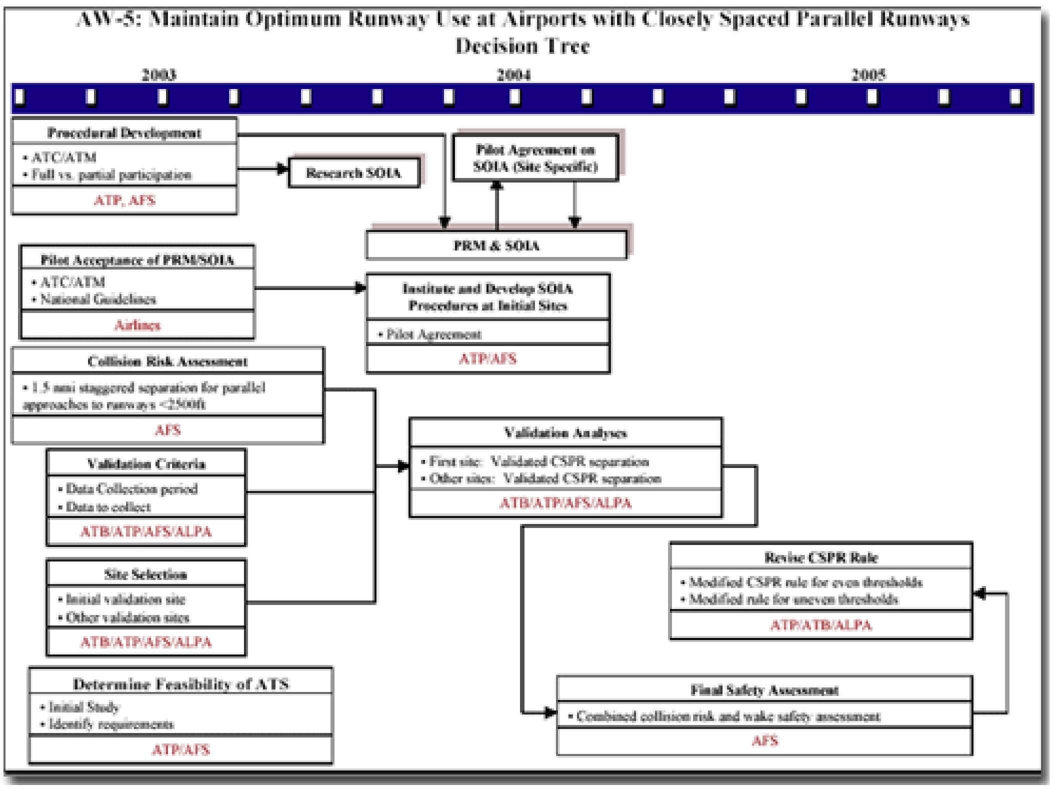
consideration staggered or even thresholds.

- Identification of phraseology to support along track separation.

## Key Risks

- Development of national criteria and requirements for along track separation.
- Dependency on a one-second update surveillance source.
- Limited applicability.
- Implementation costs.
- Pilot and controller participation and acceptance.

## Decision Tree




[View enlarged decision tree](#)

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[Relationship to the Architecture](#)

# Operational Evolution Plan

**En Route Congestion**

## ER-1
## Match Airspace Design to Demands

In en route airspace, complex traffic flows can cause bottlenecks and inefficiencies. Increased flexibility is needed to address volume, congestion and weather in en route airspace. Initially, redesign efforts will focus on optimization of existing resources by splitting and restratifying sectors, potentially creating additional sectors. Later efforts will include larger scale redesign actions, including sectorization concepts that may increase sector size and result in consolidation in the number of sectors. In the oceanic and offshore airspace, procedural and technological changes offer opportunities to realign airspace and flows. Oceanic Redesign will include resectorization and new routing within oceanic and offshore airspace, conceptualized and executed in a nationally coordinated manner over all associated facilities.

**Key Activities:**

| | |
|---|---|
| North/South Reroutes Design Completion | 1/03 |
| High Altitude Phase I Initial Implementation | 3/03 |
| ZAN Oceanic Specialty (Ocean Redesign) | 8/03 |

**Smart Sheet:**
**Version 5.0, December 2002**

### ER-1: Match Airspace Design to Demands

**Optimize and redesign en route and oceanic airspace to accommodate complexity and congestion.**

### Background

The structure of en route airspace has stayed virtually the same for the last several decades. However, demands on this airspace have significantly increased. The number of aircraft has increased, as has the diversity in the performance and type of aircraft operating (e.g., regional jets). Programs such as the North American Route Program (NRP) and Free Flight have increased the number of aircraft flying off structured air routes. These advances create both the need and the opportunity to revamp the airspace to better meet evolving customer service.

In en route airspace, complex traffic flows can cause bottlenecks that impede smooth transition to and from key airports. Increased flexibility is needed to address volume, congestion and weather in en route airspace. Operational efficiency can be compromised without this flexibility. Restrictions are put in place to manage demand for access to en route airspace when levels exceed that which can be handled safely.

In the areas where congestion routinely occurs, the only means presently available to supplement current resources is to add additional sectors (through resectorization and restratification). This requires floor space, sector equipment and spectrum to be available for this temporary resource. New methods for managing and applying needed resources to en route sectors are needed.

## Ops Change Description

The National Airspace Redesign (NAR) is the FAA initiative to review, redesign, and restructure the nation’s airspace. NAR will leverage new technologies, equipage, infrastructure, and procedural developments to maximize benefits and system efficiencies. Modernization of airspace through NAR is characterized by the migration from constrained ground-based navigation to the freedom of an RNP based system.

There are four components to NAR, three of which will deliver the desired operational change in the design and management of en route airspace:

- ER-1.1: NAR – Regional Optimization and Redesign of En Route Airspace
- ER-1.2: NAR – High Altitude Redesign
- ER-1.3: NAR – Oceanic Redesign

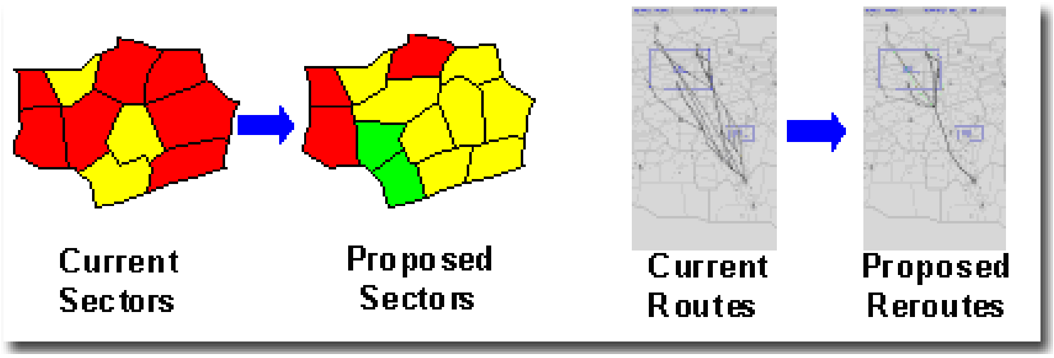
Initially, redesign efforts will focus on optimization of existing resources by splitting and restratifying sectors, potentially creating additional sectors. Later efforts will include larger scale redesign actions, including sectorization concepts that may increase sector size and result in consolidation in the number of sectors. These airspace projects while addressing problems in the en route airspace may include associated changes in the terminal airspace (see AD3).

## Benefit, Performance and Metrics

- Reduce en route delay
- Reduce the difference between flight plan time and time as flown
- Reduce the difference between flight plan distance and distance flown
- Increase the percentage of time on filed flight plan versus route flown
- Increase the percentage of time on requested cruise altitude versus altitude flown
-

- Reduce the time to obtain requested altitude
- Reduce the number of potential conflicts
- Reduce restrictions used to manage sector complexity and congestion

### ER-1.1 En Route Airspace Optimization and Redesign




### Scope and Applicability

The optimization and redesign of en route airspace consists of two main concepts. The first involves changing the number or size or shape of the sectors in the en route airspace. The second involves adjusting existing routes or developing new routes through these sectors. These techniques can be applied separately or together to alleviate congestion and complexity in the en route airspace. En route restratification, resectorization and rerouting projects are planned for all en route centers in the U.S. Plans have scheduled evolutionary implementation of these airspace projects between 2002 and 2008:

| | |
|---|---|
| Western Alaska | 2002 |
| ZDV Airspace | 2003 |
| ZOA/NCT Redesign | 2003 |
| ZTL North/South Flows | 2003 |
| ZAN Ocean Redesign | 2003 |
| ZOA/ZAN Airspace | 2003 |
| Caribbean Reroutes | 2003 |
| High Altitude Redesign Phase 1 Initial | 2003 |
| High Altitude Redesign Phase 1 Expansion | 2004 |
| ZKC East End | 2004 |
| Interior Alaska | 2004 |
| ZLC Area Realignment | 2004 |

| | |
|---|---|
| ZSE Airspace | 2004 |
| High Altitude Redesign Phase 1 Completion | 2005 |
| High Altitude Redesign Phase 2 Initial | 2005 |
| ZOA Oceanic Airspace 2005 | 2005 |
| ZMA/ZHU Gulf Reroutes | 2005 |
| Southeast Alaska | 2005 |
| Western Pacific En Route Bay-to-Basin | 2006 |
| High Altitude Redesign Phase 2 Expansion/Completion | 2006/ 2007 |
| High Altitude Redesign Phase 3 | 2008 |
| Great Lakes Corridor | 2008 |

## Key Decisions

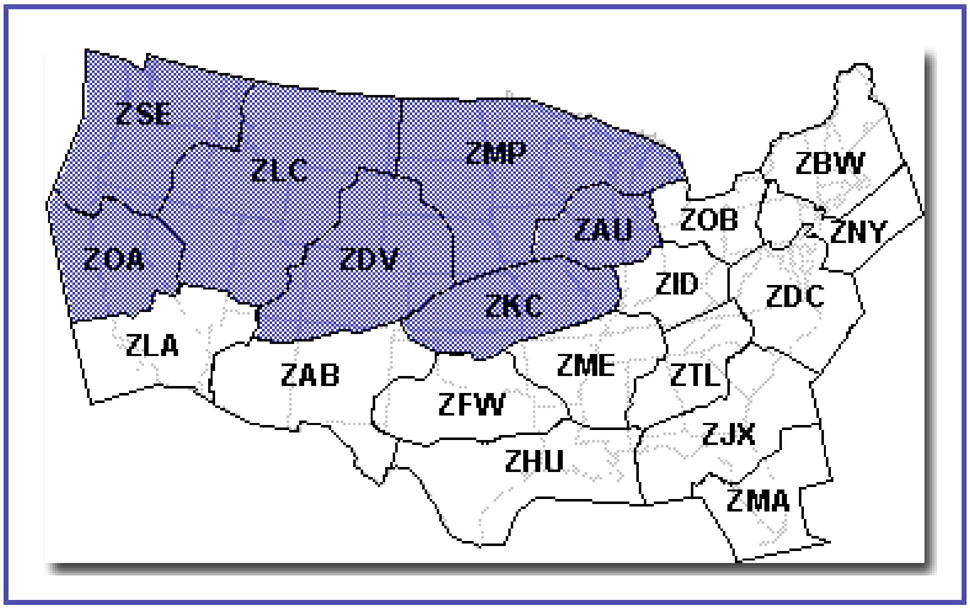
- There are currently over 700 sectors in the NAS, with over 100 additional sectors under consideration. In the near- and mid-term adding or splitting sectors may be the only way to alleviate key areas of congestion in the en route airspace. Air Traffic needs to determine the right level of sectorization, if/when it will need to pursue a strategy to reduce the number of sectors (while addressing the concerns of increased complexity and congestion) and evaluate how evolving technologies can support the reduction of the number of sectors. Any changes in sectorization policies will impact future en route design.
- The airspace design process under NAR has several points where industry, the user community and other stakeholders are asked to provide input to key decisions. Using informal methods (e.g., briefings and informational meetings) and formal methods (e.g., working with RTCA, advisory committees and public meetings), NAR teams strive to communicate plans and receive appropriate feedback. Ultimately the implementation decision responsibility lies with the FAA. The three critical decision points involving stakeholders are:
    - Characterizing the problem: this activity occurs in the first few months of an airspace project where NAR teams work with stakeholders to affirm project objectives.
    - Designing the alternative design options that will become the proposed change: here stakeholders are asked for input through scoping meetings and regular meetings with key constituencies.
    - Assessing the impact of the proposed change: once analysis has been complete, stakeholders receive feedback on impacts and pending FAA decisions.

## Key Risks

- Several infrastructure adjustments will be needed to support new sectors, including availability of building space, ATC automation, controller position equipment, and additional frequencies. Lack of availability of these systems may negatively impact the ability to transition to new sectorization or to implement additional sectors. Limitations of the current systems, specifically the HOST computer, will limit potential efficiency of some of the proposed airspace changes. Airspace projects, as they are currently proposed, do not require ERAM. NAR en route projects are scoped to leverage evolving ground and cockpit technologies. Projects described above may require an adjustment to existing infrastructure, but not on technology that does not currently exist. As the NAS modernizes, the airspace will take advantage of those new capabilities.

VTABS (VSCS Training and Backup System) capacity is limited to 50 positions in each en route center. Upgrades and expansion are not available. A proposal for program requirements or funding to provide needed additional capacity is pending. Currently no additional sectors can be added to ZAU (maxed out at 50 positions); ZOB is at 48 positions. Additional sectors are an integral part of several NAR en route projects. If the VTABS issue is not resolved, airspace changes will be delayed.

## ER-1.2 Implement High Altitude Redesign




**High Altitude Redesign – Phase 1**

### Scope and Applicability

High Altitude Redesign (HAR) is the primary means to redesign en route airspace. HAR's objective is to provide aviation users the greatest opportunity to operate on their preferred profiles and at efficient altitudes. When fully implemented, HAR will use new airspace concepts and technology to balance flexibility and structure to obtain maximum system efficiency.
HAR uses an evolutionary implementation approach timed to match airspace design, adaptation, automation, and infrastructure development timelines. This approach capitalizes on available technologies to deliver early benefits while concurrently developing the longer-term requirements. These items include sector characteristics, alignment of the airspace with existing and/or new organizational structures, and cognitive and display requirements for modification to decision support tools.

The phased implementation of HAR is as follows:

- HAR Phase 1 is planned for March 2003 and encompasses airspace at or above FL390 in seven centers: ZDV, ZSE, ZOA, ZLC, ZMP, ZKC, and ZAU. Phase 1 will implement three main operational changes:
    - Charted waypoints to efficiently circumnavigate ATCAAs and SUAs
    - Parallel RNAV routes providing structure in capacity constrained airspace (e.g. routes south from Pacific Northwest to California/Nevada)
    - Non-restrictive routing (point-to-point, user-preferred routing) will be possible, enabled by a navigational reference system (NRS) of waypoints
    - When RNP 2.0 becomes available, the following Phase 1 components will be transitioned
    - Procedural separation on SEA/PDX to SFO/LAX/LAS routes
    - Separation from ATCAA's
- The Phase 1 Expansion of NAR has a targeted implementation in 2004. Phase 1 Expansion will be a lateral expansion of HAR, moving into moderate density airspace of ZLA, ZAB, ZFW, ZHU, ZME, ZJX and ZMA. Phase 1 Expansion will exploit the newly established RNP 2 criteria and provide greater connectivity via RNP to key airports in the designated airspace. Vertical expansion will be based on user equipage and will target a floor of FL350.
- Beginning in 2005, HAR will target lowering the altitude floor to below FL350 in the Phase 1 and Phase 1 Expansion airspace, based on user equipage. Phase 1 Completion is planned for late 2005, includes geographic expansion to the Northeast (dependent on the implementation of the NY/NJ/PHL Redesign and the Great Lakes Corridor Redesign). Initial Phase 2 concepts, with reduced RNP values, will be implemented initially in low-density airspace.
- In 2006 and 2007, HAR will continue implementation with Phase 2 Expansion, into moderate density and high-density airspace, respectively.
- Phase 3 of HAR is planned for 2008 and beyond. Functionality and concepts will be finalized in the 2006 timeframe and will be dependent on the maturity of infrastructure improvements such as CPDLC and ERAM.

Later phases of the High Altitude Redesign may incorporate procedural separation on closely space routes enabled by RNP, full domestic RVSM (see ER4), and required time of arrival for transition into en route and terminal airspace.
Phase 1 provides all the characteristics required to evaluate initial changes in procedures and airspace designs. This airspace includes major city pair flows that include high altitude cruise as well as transitioning aircraft from ocean tracks. During the initial implementation, a decision will be made on the most effective next step. That is, whether to proceed by first extending the procedures and designs to lower altitudes within the seven centers or extending procedures and designs across all 20 centers.

### Key Decisions

- Users will require access to information on SUA scheduling and usage to allow them to define and file optimal trajectories. This includes information on ATCAA usage. SAMS will be the primary mechanism to provide the data. Procedures and mechanisms for public access to the data are being developed.
- The FAA needs to finalize the expansion plans for the High Altitude Redesign, including the final altitude floor.
-

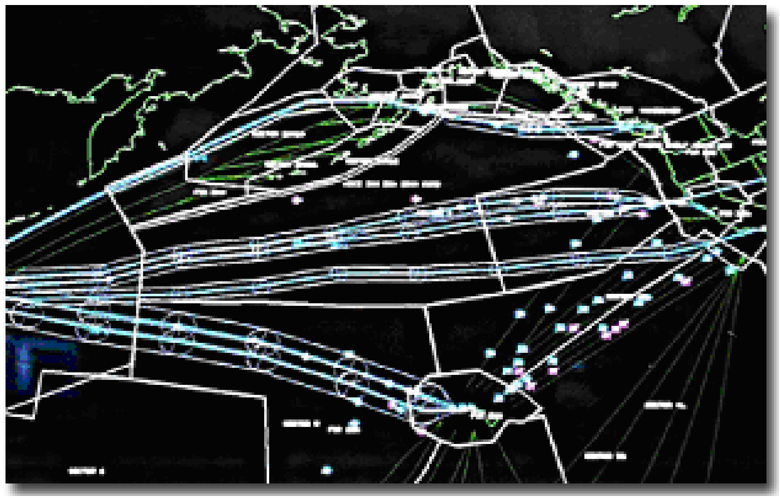
- If the decision is made for mandated equipage (e.g., RNP or RNAV) or exclusionary airspace use, rulemaking will be needed.
- Adoption of a uniform grid naming convention and its inclusion into the en route adaptation will be needed.
- The FAA should decide on the appropriate facility structure (number and size of en route facilities) to effectively support the High Altitude Concept, including management of the staffing, training, automation, displays and infrastructure to support the sectorization.
- The FAA will need to continue development of RNP criteria below RNP 2 (expected in late 2003). HAR Phase 2 concepts currently depend on reduced RNP values.
- The airspace design process under NAR has several points where industry, the user community and other stakeholders are asked to provide input to key decisions. Using informal methods (e.g., briefings and informational meetings) and formal methods (e.g., working with RTCA, advisory committees and public meetings), NAR teams strive to communicate plans and receive appropriate feedback. Ultimately the implementation decision responsibility lies with the FAA. The three critical decision points involving stakeholders are:
    - Characterizing the problem: this activity occurs in the first few months of an airspace project where NAR teams work with stakeholders to affirm project objectives.
    - Designing the alternative design options that will become the proposed change: here stakeholders are asked for input through scoping meetings and regular meetings with key constituencies.
    - Assessing the impact of the proposed change: once analysis has been complete, stakeholders receive feedback on impacts and pending FAA decisions.

### Key Risks

- Charting and real-time management of all forms of airspace usage (i.e., ATCAAs) is needed to support development of user-preferred routing that require minimal controller intervention. If the improved information is not available, then the benefit of the charted waypoints will be limited.
- The airspace users face several challenges (database issues, human factors, training, etc) that will limit their ability to be ready for the NRS by March 2003. If they are not capable of using the waypoints, the full benefits of NRR will be limited.
- Several infrastructure adjustments may be needed to support new sectors. If these systems are not available, then it may impact the ability to transition and implement HAR phases:
    - ATC Host/ERAM automation.
    - Frequencies for transitioning and new sectors; enlarging sectors would affect the ground communications infrastructure. Existing radio sites may not provide adequate coverage for the larger sectors, so two or more sites containing radios operating on the same frequency may be required.
      There may be a need to modify surveillance linkages, and existing ground automation systems may not be capable of accepting additional inputs. Other infrastructure considerations include system adaptation and the possible use of new coordinate systems.

Decision support tools (e.g., URET, CRCT capabilities, TMA) may be needed to support the non-restrictive routing and transitioning to and from High Altitude airspace. HAR phases are scoped to leverage evolving ground and cockpit technologies. As the NAS modernizes, the phases will be scoped to take advantage of those new capabilities.

### ER-1.3 Oceanic Redesign



A second national-level effort involves oceanic airspace. In next few years, major operational changes will take place in the oceanic domain. Air Traffic must determine how to adjust airspace and procedures to capitalize on these changes and provide the most efficient operations. Oceanic Redesign will include resectorization and new routing within oceanic and offshore airspace, conceptualized and executed in a nationally coordinated manner over all associated facilities.

### Scope and Applicability

Oceanic Redesign will leverage state-of-the-art technology, procedures, and programs and support uniformity of oceanic airspace. These airspace projects will focus on overcoming the limitations with how we can most efficiently manage oceanic airspace particularly with human factors, size of sectors, density, and demand for services. Oceanic Redesign will facilitate the implementation of improved airspace structures and procedures along with controller decision support tools for facilities that provide oceanic and offshore services. The planned schedules for Oceanic Redesign projects include:

| | |
|---|---|
| ZAN Ocean Redesign | 2003 |
| ZOA/ZAN Airspace | 2003 |
| Caribbean reroutes | 2003 |
| ZOA Oceanic Airspace | 2005 |
| ZMA/ZHU Gulf Routes | 2005 |

### Key Decisions

- The airspace design process under NAR has several points where industry, the user community and other stakeholders are asked to provide input to key decisions. Using informal methods (e.g., briefings and informational meetings) and formal methods (e.g., working with RTCA, advisory committees and public meetings), NAR teams strive to communicate plans and receive appropriate feedback. Ultimately the implementation decision responsibility lies with the FAA. The three critical decision points involving stakeholders are:
  - Characterizing the problem: this activity occurs in the first few months of an airspace project where NAR teams work with stakeholders to affirm project objectives.

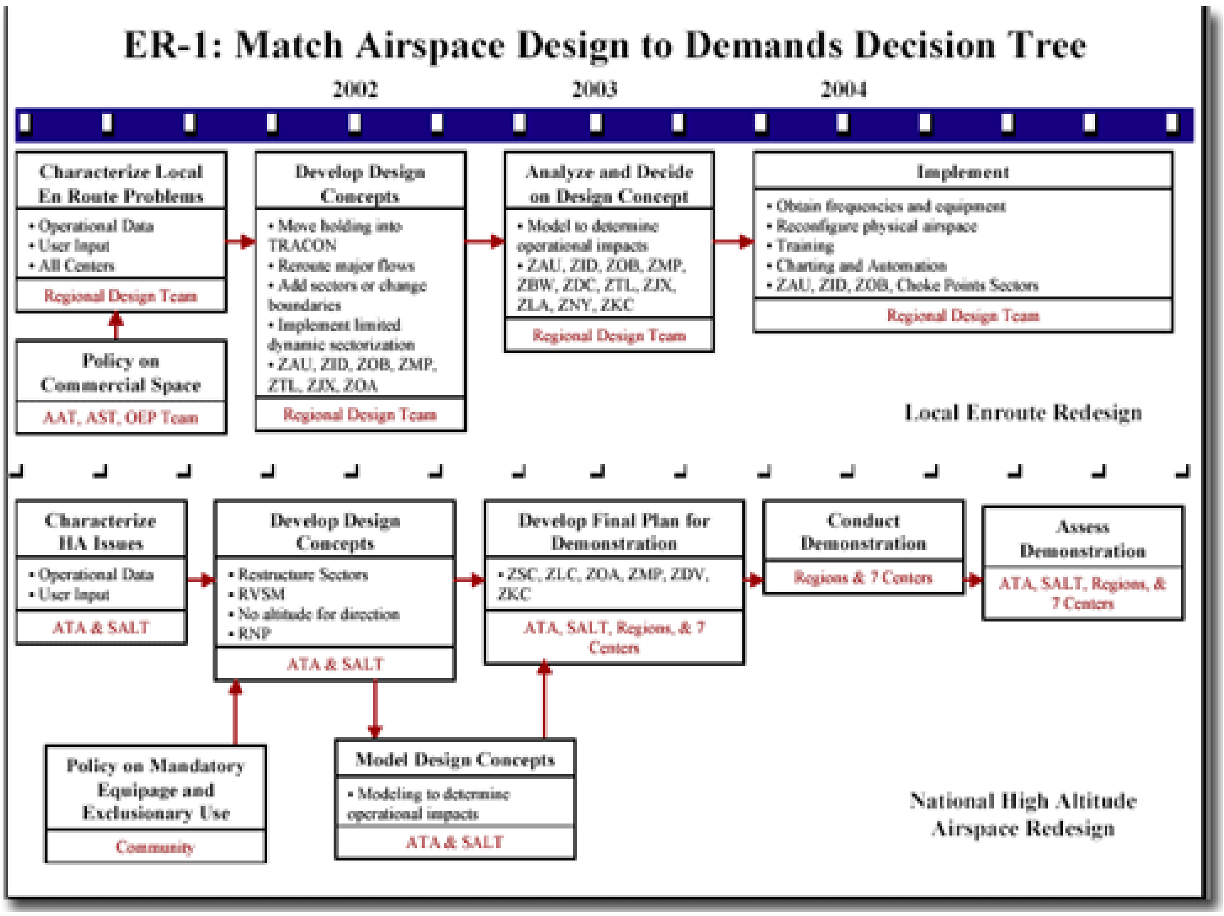
Designing the alternative design options that will become the proposed change: here stakeholders are asked for input through scoping meetings and regular meetings with key constituencies.

Assessing the impact of the proposed change: once analysis has been complete, stakeholders receive feedback on impacts and pending FAA decisions.

## Key Risks

None

## Decision Tree




[View enlarged decision tree]

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Regional Airspace Focus Leadership Teams

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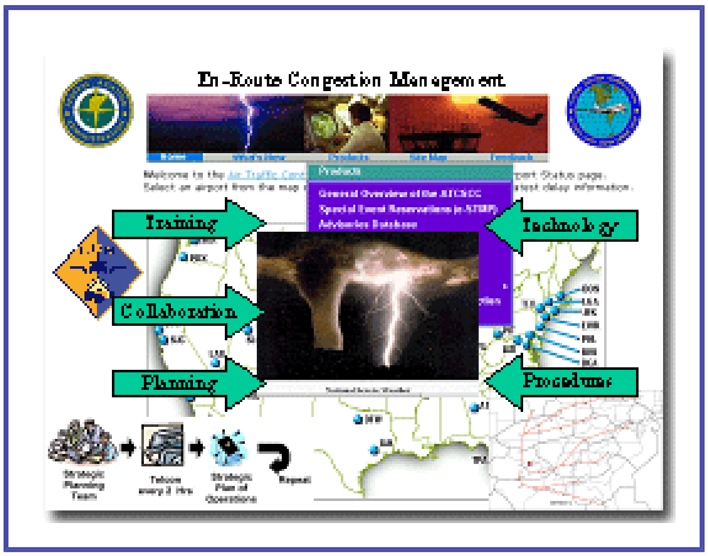
RTCA FFSC AWG (and subgroups)
TOARC

***Other Websites***
[Relationship to the Architecture]
www.faa.gov/ats/nar/
www.faa.gov/ats/atp/RNAV.cfm

## ER-2
## Collaborate to Manage Congestion




Congestion may appear for brief periods of time at non-routine locations or at different hours of the day. Such congestion may be avoided by sharing predictions with users and allowing them to plan accordingly. Coordination of a game-plan for likely events is done ahead of time to ensure an effective response. Based on results from the collaborative process used for the severe weather season of spring/summer 2002, a program of training has been implemented to prepare controllers, pilots, and airline dispatchers for the spring/summer 2003 activity. Collaborative decision making and information sharing will continue to be emphasized to respond to en route congestion.

### Key Activities:

| | |
|---|---|
| Revised FEA/FCA procedures | May 03 |
| Expand TMNL to all en route centers | 2004 |
| DSP R&D Multi Center Ops | 2003 |
| FSM Java Client | August 2003 |
| | |

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|---|---|
| Develop TFM modernization timeline | 2003 |
| Reroute Advisory Tool (RAT) | Summer 03 |
| CDM Training Subcommittee | Spring 03 |
| Route Management Tool (RMT) Version 1.3 | January 03 |
| ETMS V7.6 | May 03 |

**Smart Sheet:**
**Version 5.0, December 2002**

Air traffic congestion can be predicted at major convergence points in the NAS based on airline schedules and historical demand. In addition, congestion may appear at non-routine locations or at different hours based on changing wind configurations, location of hazardous weather conditions, or other dynamic shifts in the norm. Common situational awareness of a predicted congestion area shared by the user and service provider can reveal means to collaborate on mitigation of the constraint. For example, coordination of a game plan for likely events may be done ahead of time to ensure an effective response. Results from the collaborative process used for the severe weather season of Spring/Summer 2000 were used to develop a training program, implemented for Spring/Summer 2001, which prepared controllers, pilots, and airline dispatchers to manage the congestion systemically. Collaborative decision making and information sharing will continue to be emphasized in response to en route congestion for 2003 and beyond.

## ER-2: En-Route Congestion Management:

**Processes, procedures and techniques to collaboratively mitigate en route congestion, include timely identification of en route impacts, improved route predictability and flexibility.**

### Background

Certain areas of the National Airspace System (NAS), particularly the area from Chicago to the northeastern U.S. corridor and others east of the Mississippi River, are highly complex and geographically limited. In these areas, traffic increases during peak demand periods combined with decreases in capacity routinely lead to congestion and delays. Even under optimum conditions this can have a ripple effect throughout the NAS.
Balancing capacity and demand in the NAS requires a system wide choreographed effort to minimize service disruption. The Strategic Planning Team (SPT) process, launched by the Spring/Summer 2000 initiative, was designed to foster collaborative solutions. The SPT conducts a telcon among the major facilities and the user community every two hours to discuss the status of the system, constraint projection, and to develop the Strategic Plan of Operations (SPO). The SPO is a collaborative agreement on how to deal with severe weather and other system constraints, and ensure a degree of predictability for all stakeholders by providing a common view of system issues with a look ahead of two to four hours. The Spring of 2000 was the inaugural year for the SPT/SPO process. Significant progress was made during the severe weather season of 2000, and annual reviews of operational rules and processes have resulted in further improvements. Since the inception of the S2K initiative, suggestions were made to enhance and evolve the collaborative process. Changes included increasing specificity in the strategic plan, finding balance in meeting stakeholder objectives, thus reducing the need for tactical initiatives through improved planning; improving communication methods and improving technology and increasing strategic planning telcons to 24 hour coverage.

The Collaborative Decision Making (CDM) Program is a joint Government/Industry initiative to develop new technology and procedures that ensure a safe and efficient NAS, beneficial to everyone in the aviation community and the flying public. CDM focuses on a number of traffic flow management initiatives to create common situational awareness, accurate demand predictions, increased predictability, and improved system planning and execution. The following represents some of the initiatives: National Play book, Coded Departure Routes (CDR), Route Management Tool (RMT), Pathfinder and Diversion Recovery Web pages, Flight Schedule Monitor (FSM), Common Constraint Situation Display (CCSD), Flow Constrained Area (FCA)/Flow Evaluation Areas (FEA), Integrated Traffic Flow Management (ITFM) Traffic Flow Management Core Technologies and Evolution. Working together requires mutual understanding and acceptance of respective roles and responsibilities. CDM initiatives seek to create common situational awareness of traffic congestion and constraints in the national airspace system. With accurate predictions of demand constraints, users can avoid congested routes thereby reducing delays and the need for ATC rerouting. Common situational awareness, or sharing data, benefits both the aviation community and the flying public.

Route management remains relatively inflexible due to rigid airspace design, continued use of ground based Navaids, incompatible databases and automation systems between users' flight planning systems, FAA HOST requirements, and aircraft navigation systems. Advanced aircraft navigation systems have remained largely unused due to an inflexible airspace structure. Poor communication of route and airspace status continues to plague the system resulting in inefficient use of available resources. Additionally, the inability to communicate flight plan changes quickly slows the process and is workload intensive for all stakeholders resulting in increased flight delays.

### Ops Change Description

Operational changes will be seen as ongoing improvements in the process of collaboratively managing en route congestion. Traffic Flow Management (TFM) will undergo an evolution that improves identification of constraints, provides common situational awareness, and enhances collaboration on a solution.

The collaborative decision making concept will continue to be refined with decisions distributed among national and local TFM, en route controllers, and Airline Operations Centers (AOCs, a generic term, includes FOCs, OCCs, etc.). Tactical collaboration with NAS users analogous to SPT will be expanded and aimed at improving execution of strategic plans as they are refined tactically to meet changing conditions. Greater focus will be brought to system recovery techniques and mitigation of traffic management initiatives (TMIs) as the need for their use expires.

Improved information on current and forecast traffic, areas of congestion, and weather shared among service providers and NAS users will enable better decisions in reactive, collaborative, and preemptive modes in order to respond to existing and predicted congestion and to prevent congestion from occurring. The mechanisms needed to realize improvements include better planning, procedures, technology (information exchange systems and decision support tools), and training.

**Planning:** Collaborative Strategic Planning will aid in identification, and common situational awareness of impacted airspace utilizing new technologies will aid in applying solutions. New data-sharing systems and communication-sharing methods, such as the Traffic Management National Log (TMNL), the Air Traffic Control System Command Center (ATCSCC) web site, the Common Constraint Situation Display (CCSD), and the Web Situation Display (WSD) will enhance collaboration for both internal and external traffic managers.

**Procedures:** Operational changes will include process and procedure improvements as identified through analysis, feedback and review. New technologies will be integrated as they are made available to service providers and users. Route management will be a collaborative effort between the FAA and users to assure flight safety (relative to fuel, hazardous weather, etc.) as well as to assure that traffic volume and complexity concerns are considered to guarantee safe separation of aircraft from aircraft. Activating alternative routes utilizing the National Playbook, Coded Departure Routes, area navigation (RNAV), as well as dynamic utilization of Canadian Routes and military airspace will provide additional options during situations where normal routes are congested or impassable.

**Technology:**

**New ETMS functionality:** There will be increased collaboration and greater common situational awareness by utilization of new technologies such as the Flow Evaluation Area (FEA) and Flow Constrained Area (FCA). FEA/FCA functions available to Traffic Management Units (TMUs) on the Traffic Situation Displays (TSD). The NAS user likewise will access and discuss public FCAs through the use of the Common Constraint Situation Display (CCSD), which provides web based access to the Enhanced Traffic Management System (ETMS).

**New FSM functionality:** Enhancements and greater distribution of the Flight Schedule Monitor (FSM) will provide airport traffic demand and capacity maximization capabilities. Improvements in Ground Delay Programs (GDP) functionality and refinement of ground stop (GS) procedures in conjunction with FEA/FCA functionality will provide alternatives to collaboratively manage severe weather constraints in the en-route environment.

**Training:** S2K+N, yearly training will be an integral part of successful implementation of solutions.

**CDM Joint Training subcommittee:** The CDM training subcommittee's mission is to develop and implement a joint FAA/Aviation Stakeholder training process to include both initial and recurrent training. The objective of the training is to educate stakeholders on the roles and responsibilities of operating within the NAS. To make an operational change stakeholders will be trained on situational awareness, system planning and application of traffic flow management technologies. This will increase system predictability and performance.

The operational changes are evolutionary and thus will span the entire timeframe of near, middle and long term (2003-2013) and beyond. The sub-groups will address these changes in more detail.

- ER-2.1: Improved collaboration and communication through planning, procedures and data sharing.
  2.1.1 Strategic Planning - S2K+N
  2.1.2 Information, data access and data sharing
- ER-2.2: Route Management (Improve coordination and implementation of alternative routes)
  2.2.1 Re route Advisory Tool (RAT)
  2.2.2 Playbook
  2.2.3 RMT/CDR
  2.2.4 Dynamic utilization of alternative routes through Military airspace
  2.2.5 Dynamic utilization of alternative routes through Canadian airspace
- ER-2.3: Technology:
  2.3.1 Existing technology improvements
  2.3.2 Research and Development
  2.3.3 Systems Integration
- ER-2.4: Training: Joint FAA/Industry Initial and Recurrent Training Process

### Benefit, Performance and Metrics

The following metrics may be used to measure NAS system performance.

**NAS Level OEP Metrics**
Primary: Average delay per flight and average daily flights
Additional NAS Level Metrics:

- Percent of Flights on Time
- Average Minutes of delay per flight
- Ground Stop Minutes/Average Duration
- Ground Delay Program Minutes/Average Duration
- Total Number of Ground Delay Minutes
- Average Daily Arrival Capacity
- Average Daily Flights
- Airport Efficiency Rate
- Average Airborne Delay, Average Block Delay
- Capacity/Throughput (VMC, IMC)
- Total Number of System Delays
- Revenue Passenger Miles, Available Seat Miles

**En Route Metrics**
Primary:

- Average En Route Delay
- Peak En Route Throughput/Peak En Route Throughput Index (PERTI)

Additional Capacity and Throughput En Route Metrics:

- Percentage of flights flown as filed
- Peak Sector and Center Throughput
- Total, Average, Percentage of Gate Delays
- Rate of Access to SUA
- Average Speed En Route

Additional Efficiency En Route Metrics:

- Average, Total and Minimum Block Time
- Average Block Delay
- Average, Total and Minimum Airborne Time
- Average Airborne Delay
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- Total Number and Average Duration Ground Stops
- Total Number and Average Duration Ground Delay Programs
- Number of Diversions
- On-Time Performance
- Average, Total, and Minimum Time En Route.

## ER-2.1: Improved Collaboration and Communication through Planning, Procedures and Information sharing

### Scope and Applicability

The key element underlying ER 2.1 is working together to create system success. Collaboration and common situational awareness derived from collaborative system planning, data sharing methods and CDM programs are expected to produce operational changes throughout the entire time range of the OEP (2003-2013).

Collaborative Decision-Making (CDM) embraces three basic principles, data exchange, distributed planning, and performance analysis.
1. Data exchange. Create common situational awareness through shared information to keep all parties aware of system demand and constraints.
2. Distributed planning. NAS stakeholders can provide input into traffic management decisions to ensure that limited resources are used in a manner that accommodates individual business needs.
3. Performance analysis. CDM uses performance analysis data and experience to further enhance system performance.

The ER-2.1 solution set, "Improved Collaboration and Communication through planning, procedures and information sharing, will focus on the principle elements of CDM and includes the following sub-groups:

> 2.1.1 Strategic Planning; (SPT) process (S2K+N)
> 2.1.2 Information, data sharing, and data access between FAA facilities and Users (i.e. Airlines)

**2.1.1 Strategic Planning – S2K+N:**

The strategic planning process, which was initiated during the spring of 2000, is the foundation of NAS collaboration on a daily basis. Recommendations for yearly improvements are addressed by an S2K+N steering committee. Specific tasks may be requested through other sub-groups or organizations.

**Near Term: (2003-2005):**

- Evaluate need for "Flexible Rules of Operation" for varying states of the NAS
- Process improvements as identified through lessons learned reviews will be identified and implemented as applicable

**Mid Term: (2006 –2009):**

- Mid term is dependent on process analysis and feedback from the near term.

**Long Term: (2010 –2013):**
Undefined

**2.1.2 Information, data sharing, and data access between FAA facilities and Industry (i.e. Airlines, NBAA, RAA, Military):**

Data exchange is a basic principle of CDM; therefore, the CDM leadership team has identified this item as a key element in the success to operational change.

**Information (Data) Sharing Methods:**

**ATCSCC WEB: Internet**
The information provided on the ATCSCC web site, Internet, provides timely NAS status information for use by aviation entities as well as the general public.

**ATCSCC WEB: Intranet**
The information provided on the ATCSCC web site, Intranet, provides FAA facilities timely NAS status information. CDM participants are provided access to the data through the CDMnet as noted in the following section.

**Collaborative Decision Making Network (CDMnet)**
The CDMnet is a network routed through the Volpe Center providing two-way real-time operational data exchange such as cancellation information and NAS status.

**Near Term: (2003-2005):**

- As part of the CDM work plan, specific data elements will be identified and requirements defined to achieve this goal
- Develop a plan to transition and incorporate NAS status information into the CDMnet creating an open system architecture. Allow traffic flow management core technologies from which system Users can access data for development of decision support systems
- Develop a plan to ensure the incorporation of changing security standards
- Continued expansion and use of the diversion recovery tool (DRT)
- Continued proof of concept exploration of the pathfinder tool

**Mid Term: (2006 –2009)**

- Continued identification and dissemination of NAS status information through the appropriate infrastructure mechanism (for example, the CDMnet, FAA Internet, FAA Intranet). Mid term goals are dependent on the outcome of near term requirements and prioritization.

**Long Term: (2010 –2013):**

- Continued identification and dissemination of NAS status information through the appropriate infrastructure mechanism. Long term goals are dependent on the outcome of near term requirement and prioritization.

**Information (Data) Collection and Communication Methods**

**<u>Traffic Management National Log (TMNL)</u>**

The FAA's Traffic Management National Log (TMNL) is a FAA Air Traffic Services computer based communications and reporting system, accessible to Industry and Canadian ATC facilities. The TMNL enables controllers and traffic management personnel to record and distribute daily operational information with a single point of entry. TMNL will provide a more efficient method of capturing and disseminating information on restrictions (e.g., airport runway configuration changes can be entered and effected facilities addressed for notification). It will also identify capacity constraints regularly appearing in daily operations, allowing a greater focus towards mitigation.

**Near Term (2003 – 2005)**

- Continued expansion of the TMNL to all Air Route Traffic Control Centers (ARTCC)
- Identification of data connectivity requirements, including hardware requirements.
- Develop an implementation plan and timelines to extract restriction (MIT, ground stop and ground delay program) information from NTML into the CDMnet.

**Mid Term (2006 –2009)**

- Mid term dependent on near term requirement identification.

**Long Term (2010 – 2013)**

- Long term dependent on near term requirement identification.

**Data Quality**

The operational change expected through data quality enhancements will be improved predictability of the demand on NAS resources. Data quality spans a wide range of topics, notably for NAS predictions, flight plan intent information and accurate gate departure time have been identified as key data points that may produce the desired outcome.

**Near Term: (2003-2005):**

**All NAS Users**

- Create a tracking mechanism for identification and resolution of data quality issues
- Identify early intent flight plan data process
- Reduction of time-out cancellations impacts
- Reduction of "Pop-up" flights during ground delay programs

**Scheduled Air Carriers**

- Plan identification for use of flight times (Out Off On In (OOOI)

**Other NAS users (general aviation)**

- Identify and develop requirements for improvements in data quality

**Mid Term: (2006 – 2009):**

- Continuous improvement of data provided by the FAA and NAS users for enhanced collaboration.
- Develop single source processing for multiple traffic management systems, (ARTS, HOST, ETMS)
- Mid term is dependent on near term requirement identification.

**Long Term: (2010-2013):**

- Continuous improvement of data provided by the FAA and NAS users for enhanced collaboration.
- Long term is dependent on near term requirement identification.

### Key Decisions

- Data quality standards adopted (e.g., timely cancellation notification that will allow maximum utilization of available airport capacity).
- Data sharing parameters adopted (e.g., inclusion of GA flight intent as early as possible).
- Common metrics identified for operational analysis and problem identification.
- Common goals and targets adopted to achieve a "System Thinking" approach.
- Identify the benefits of compliance and risk to non-compliance

### Key Risks

- Access to data and information that is currently considered to be sensitive or company proprietary is at issue. There are security, company proprietary, and privacy restrictions on some of the information that has been requested for inclusion in the information exchange.
- The numbers of stakeholders (airspace users and FAA facilities) that need to be involved in the collaborative participation, due to incomplete intent data, the need for an agreed upon reduced en route capacity rationing process.
- Systems connectivity between stakeholders may not be fully established due to the diversity of stakeholder systems or operational environments. For example, major air carriers AOC fully connected to decision support tools through the CDMNet versus a single business jet operator whose preflight information comes from an Fixed Base Operator (FBO) or DUATS.

### ER-2.2: Route Management (Improve coordination and implementation of alternative routes)

### · Scope and Applicability

Current procedures require excessive coordination and time. Developing routings and entering amendments to flight plans impact system efficiency and create delays.
Managing system constraints, as well as, route management, is a collaborative effort between the FAA and Industry stakeholders to maximize system performance and capacity while ensuring safety of flight (i.e. relative to fuel, hazardous weather, volume, complexity, existing separation standards, etc.)

Goals to reduce route coordination time and enhance system efficiency through the creation of common situational awareness of potential route alternatives are:
1. Improve updating process for ARTCC facilities.
2. Incorporate graphic presentation and play book information
3. Implement and improve coordination procedures and route development options.

The ER-2.2 solution set, “Route Management” includes the following sub-groups:

2.2.1 Reroute Advisory Tool RAT
2.2.2 The National Playbook
2.2.3 Route Management Tool (RMT)/Coded Departure Routes (CDR)
2.2.4 Dynamic utilization of alternative routes through Military airspace
2.2.5 Dynamic utilization of alternative routes through Canadian airspace

**2.2.1 Reroute Advisory Team (RAT)**

Reroute Advisory Team (RAT) was formed with the task of improving the reroute advisories that are issued by the Command Center. The RAT thinking is that when the Command Center issues an advisory, it wants certain flights to be on certain routes, and the advisory should, therefore, be designed to maximize the chance that this will happen.

To achieve this, the RAT has set three goals:
1. To improve the language that is used in reroute advisories so that there is no ambiguity and so that all FAA and NAS user personnel can properly interpret these advisories.
2. To accompany each reroute advisory with a list of affected flights so that everyone will have a clear idea of which flights are relevant.
3. To provide this list of affected flights in a machine-readable form so those NAS users can deal with it efficiently. If these goals are achieved, advantages of decreased workload, increased speed of implementation, and improved compliance with the reroute advisories are expected

**Near Term (2003-2005):**

- Proof of concept exploration
- To improve the nomenclature used in reroute advisories to reduce ambiguity.
- To provide a relevant flight list accompanying each reroute advisory.
- To provide machine-readable flight list for automation efficiently.

**Mid Term (2006- 2009)**

- Mid term is dependent on near term successes

**Long Term (2010 –2013)**
Long term is dependent on near term successes.

**2.2.2 The National Playbook (Playbook):**

The National Playbook is collection a predefined, pre-coordinated alternative routes which reduces coordination/collaboration time and allows for a quicker response to changing NAS conditions.

**Near Term: (2003-2005):**

- Implement continuous improvement process for future development of the Playbook to include a tool integration plan.

**Mid Term: (2006 – 2009):**

- Playbook based automation procedures.(Specific tasks undefined)

**Long Term: (2010-2013):**
Undefined

**2.2.3 Route Management Tool (RMT)/Coded Departure Routes (CDR) (RMT/CDR)**

The CDR utility in RMT is a combination of coded air traffic routings and refined coordination procedures designed to mitigate the potential adverse impact of severe weather or other departure congestion events. RMT is a database query tool that allows users to view the centralized Coded Departure Routes (CDR) database and related tables from the National Flight Data Center (NFDC). Future versions of RMT will include other sources of routing information; for example, the National Playbook.

**Near Term: (2003-2005):**

- Continued refinement of the RMT

**Mid Term: (2006 – 2009):**
Undefined

**Long Term: (2010-2013):**
Undefined

**2.2.3 Military Airspace: Dynamic utilization of alternative routes through Military airspace**

Dynamic access to Military airspace along the Eastern Seaboard provides a valuable routing resource during severe weather events. The development of the VACAPE SWAP (VS) routes within the warning area airspace has provided an improved method to coordinate the release of needed airspace to provide a series of timely routing alternatives.

**Near Term: (2003-2005):**

- Continuous improvement of use and application of VS routes and dynamic usage of all military airspace
- Develop and implement transition routes to Florida destinations. (Once this is completed and

implemented we will have achieved our goal on the East Coast.

**Mid Term: (2006 – 2009):**
Not required

**Long Term: (2010-2013):**
Not required

**2.2.4 Canadian Airspace Dynamic utilization of alternative routes through Canadian Airspace.**

System constraints coupled with lack of available routes impact system efficiency and capacity. Canadian offload/severe weather routes are a series of RNAV routes that can be used during periods of domestic system constraint or as customer initiated routing alternative.

**Near Term: (2003-2005):**

- Increase efficiency and throughput of Canadian airspace by expanding automation compatibility between the United States and Canadian facilities.

**Mid Term: (2006 – 2009):**

- Increase efficiency and throughput of Canadian airspace by implementing automated hand-off automation compatibility between the United States and Canadian facilities.

**Long Term: (2010-2013):**

- Not required. We will have achieved our goal once automated flight plan processing and handoff capabilities have been implemented.

**Key Decisions:**

**Key Risks:**

- Limited availability of airspace in high volume situations that often occur in the Northeast during severe weather.
- Arrival and departure routing within terminal areas is limited by what can be accommodated adequately within prior environmental studies.
- Major additions to routes in terminal areas require design studies including environmental impact assessments.
- Dynamics of tactical real-time situations often require revision of pre-planned options.
- Improved coordination and communication when activating pre-planned options or changes to pre-planned options may require automation improvements to FAA/User systems.

**ER-2.3: Technology: Improved Predictability of Congestion and Resolution Assessment**

**Scope and Applicability**

The enhancements of existing decision support systems (DSS) and the addition of new DSS tools will improve the timeliness, accuracy, and quality of congestion predictions and resolutions. In the near, mid, and long term, continuous improvement programs will increase predictability of congestion and provide quality resolution assessment. These improvements in the information available to users and service providers are expected to result in better collaborative management of congestion. In particular, congestion management should become more pre-emptive and less reactive as these enhancements are implemented.
The ER-2.3 solution set, "Technology" will include the following sub-sets:

2.3.1 Existing Technology Improvements
2.3.2 Research and Development
2.3.2.1 Integrated Traffic Flow Management (ITFM)
2.3.2.2 Traffic Flow Management Modernization (TFM-M)
2.3.3 Systems Integration

**2.3.1 Existing Technology Improvements**

The Enhanced Traffic Flow Management System (ETMS) and the Flight Schedule Monitor (FSM) form the Traffic Flow Management Decision Support System Infrastructure. The Departure Spacing Program is a prototype system in use in the New York TRACON and Center. Improvements are planned for both the existing Infrastructure systems as well as in the functional capabilities.

- **<u>Enhanced Traffic Management System (ETMS)</u>**
  The ETMS is a network of processors and workstations used to track and predict traffic flows, analyze effects of ground delays or weather delays, evaluate alternative routing strategies, and plan flow patterns. It is a flight data processing and distribution system that utilizes historical flight routings, flight intent information, and actual aircraft position.
- **<u>Traffic Situation Display (TSD)</u>**
  The TSD is a sub-system of the ETMS. It provides NAS data, constraint information (monitor alert parameters (MAP), Flow Evaluation Area (FEA) and Flow Constrained Area (FCA), flight data, and composite weather radar to the ATCSCC, and field facilities.
  The FEA/FCA functions are available to Traffic Management Units (TMUs) on the Traffic Situation Displays (TSD). FCA's provide identification of specific flights that will be affected by a NAS constraint and assist in developing traffic flow management alternatives. User access of TSD display information through the Common Constraint Situation Display (CCSD) will allow collaboration for identifying airspace constraints and routing solutions.

**Near Term: (2003-2005):**

- Continued refinement of Flow Evaluation Area (FEA)/ Flow Constraint Area (FCA) procedures through the CDM/CR FEA/FCA WG.

**Mid Term: (2006 – 2009):**

- Improve ETMS data for predictability in order to make better traffic management decisions, for example implement an early intent filing process (three to four hour pre-departure); see Data Quality, section 2.1.2.
- Playbook based automation procedures to support FCA/FEA solution alternatives

**Long Term: (2010-2013):**
Long term is dependant on success in the near and mid terms (Specific tasks undefined)

- **Flight Schedule Monitor (FSM) Enhancements**

The FAA Air Traffic Control System Command Center (ATCSCC) uses FSM for traffic flow management decision making by monitoring airports, viewing demand versus capacity and modeling ground delay programs and ground stops throughout the NAS. Flight Schedule Monitor (FSM) creates common situational awareness among the users, field facilities and the ATCSCC. Enhancements to FSM are continually being evaluated through the CDM arrival and departures (A and D) work group.

**Near Term: (2003-2005):**

- Proof of concept exploration, Human in the Loop (HITL) testing and prioritization of the following enhancements:
  • Distance based GDP's (additional HITL testing required)
  • Multi-airport GDPs (additional HITL testing required)
  • SCS ( additional HITL testing required)

**Mid Term: (2006 – 2009):**

- Mid term is dependent on near term successes.
- Proof of concept exploration for
  • Multi-fix GDPs, (additional HITL testing required)
  • Playbook based GDP

**Long Term: (2010-2013):**

- Long term is dependent on near term successes.

- **Departure Spacing Program (DSP)**

  DSP assigns a departure time to achieve a constant flow of traffic over a common point. Runway and departure procedures must be considered for accurate projections.

  **Near Term: (2003-2005):**

  · Continued review of DSP use in New York Center (ZNY) and TRACON (N90)
  · Expand evaluation to the Boston (ZBW) and Washington (ZDC) Centers
  · Eliminate arbitrary and defensive MIT restrictions

  **Mid Term: (2006 – 2009):**
  Undefined
  **Long Term: (2010-2013):**
  Undefined

**2.3.2 Research and Development:**

**Near Term Research (2003 – 2005)**

**Research Infrastructure**

The current method for analyzing the operational maturity of proposed changes to the TFM systems relies heavily on live testing of new techniques, procedures and automation. Although successfully used in the past to develop and deploy beneficial capabilities to the NAS, CDM proposed concepts for managing en-route congestion are becoming significantly more complex and require a realistic simulation/test-bed environment before doing a live test.

Our collective ability to propose a suitable solution to congestion issues greatly depends on our ability to gather and analyze data in a post operational fashion. It also requires a deliberate departure from conventional methods of research that rely solely on the evolution of existing tools, pre-determined solution sets and anecdotal evidence. Therefore, we require an infrastructure to analyze performance data and trends to pinpoint specific problems.

1. We will deploy and support a suitable human in the loop (HITL) environment to provide a platform for the User and the FAA to refine CDM concepts in support of improved handling en-route congestion.
2. We will architect, archive, facilitate, share and consolidate to the extent possible TFM related data to aid our collective ability to define problems, provide metrics and establish performance parameters to expedite our research activities.
3. The recent creation of the TFM/DSP lab in the Tech Center will provide key insights.

**TFM Decision Support Tools Research**

- Irregular operations recovery focus tools
- Interactive TFM through improved insight into airport conditions and departure queuing, including departure flow management with respect to the en-route constraints.
- Improved system impact assessment capability to evaluate TFM strategies and monitor progress towards selected initiatives.
- Improved equity through common situation awareness, access to system constraint information and improved predictability in the system.

**Mid to Long Term Research (2006 – 2013):**

Although these research initiatives are deemed to be completed in the mid to longer term, it is expected that early findings can be incorporated within the existing TFM infrastructure in the near term.

**Improved Strategic Planning Capacity**

The current methods for assessing NAS system impact as a result of constraints such as weather and volume do not handle the uncertainty associated with their prediction. As a result, air traffic and dispatchers are limited in their abilities to properly strategize, collaborate and effectively mitigate the constraints.

We will perform research in the following areas to improve our collective ability to identify constraints in a timely fashion and establish suitable alternatives to react effectively to them.
1. Use of artificial intelligence, genetic algorithms and other techniques to identify congestion and deliver suitable strategies to avoid it.
2. Early intent information
3. Application of distributed command and control techniques.

**Improved Execution of Flow Strategies**

In some cases the existing flow of TFM related information is not reaching the appropriate decision maker in a timely manner to react effectively to planning initiatives. The existence of multiple standalone systems that support single decision treads is a source of workload and lost efficiency.

We will be performing research to discover where these gaps in the command and control structure currently exist. To accomplish this we will use the following approaches and techniques to identify, prioritize and propos the development of an appropriate solution:
1. Examine cross-domain (FOC, Enroute, TFM, Wx) data exchange requirements.
2. Define operational concepts for decision making to improve the dissemination and implementation of system wide strategic initiatives.

### 2.3.2.1 Integrated Traffic Flow Management (ITFM)

- CDM Integrated Traffic Flow Management
  The existing technology and procedures to manage en route demand during periods of constraint are inefficient. Developing integrated technology and procedures where dispatchers and system operators can file a flight plan querying the health of the NAS that will provide feedback on their route request and alternatives. Once they make decisions, they can lock in the routes thus providing a "carrot" for early intent filing and supporting our need for timely and accurate data.
  Goals to achieve this are:
  1. Develop global situational awareness.
  2. Develop interactive tools and methods to identify system constraints, alternatives and provide the user the opportunity to make economic decisions.
  3. Develop interactive tool based on timely and accurate flight plan data and system capacity that will allocate the available airspace resource in an efficient and equitable manner.
  4. The recent creation of the TFM/DSP lab in the Tech Center will provide key insights.

### 2.3.2.2 Traffic Flow Management Modernization (TFM-M)

The TFM automation infrastructure is the foundation for the decision support services that are provided by the TFM domain. A Flexible infrastructure is needed to support incorporation of the numerous products that are expected to mature from the Research and Development activities that are currently underway. If the infrastructure is not flexible, the time to incorporate the new capabilities will be much longer and there may be some capabilities that would be impossible to incorporate without a major, prohibitive change. The TFM-M program is planned to modernize the TFM automation infrastructure.

**Near Term (2003 – 2005)**

- Complete a TFM-M needs assessment review and develop a timeline for TFMM implementation.
- Establish requirements for the TFM-M
- Initiate a program for design and development of TFM-M
- Establish collaborative link to CDM ITFM team

**Mid Term: (2006 – 2009):**

- Complete the modernization based on the identified needs assessment developed during the near term.

· **Long Term: (2010-2013):**
Undefined

**2.3.3 System Integration**

Improved integration of existing data and decision support tools based on definition of desired operational concept and recommended requirements.

**Near Term: (2003-2005):**

- Identify the appropriate communication infrastructure to integrate NAS system information currently contained in closed system architecture into existing/enhanced CDMnet, for example, airport surface information currently being displayed in systems such as DSP.
- Enhance the CCSD mechanism to provide ETMS hub functionality.
- Conduct evaluations of existing tools
- Develop a concept of operations document
- Develop a requirements document
- Develop an integration plan by the end of 2003, which includes appropriate time windows

**Mid Term: (2006 – 2009):**

- Mid term dependent on near term developments

**Long Term: (2010-2013):**

- Mid term dependent on near term developments

**Key Decisions**

- Define collaborative processes and procedures for using FCA capabilities in ETMS.

**Key Risk**

- ·Investment on the part of the user community may be required for software integration with existing industry decision support and flight plan processing systems.

**ER-2.4 Training: Expansion of Joint FAA/Airline Initial Training, Recurrent Training, and Analysis**

**Scope and Applicability**

All participants in planning for traffic flow management (Users and FAA) need to have common training on Traffic Flow Management (TFM) techniques, procedures, and processes. The following programs have begun prior to the Spring 2001 convective weather season and will be on going as part of a continuous improvement process.

**Near Term: (2003-2005):**

Yearly

- Development of the training program for 2003 will build off the successes of an integrated training concept employing development and delivery consistent with the collaborative approach.

**Mid Term: (2006 – 2009):**
Yearly

**Long Term: (2010-2013):**
Yearly

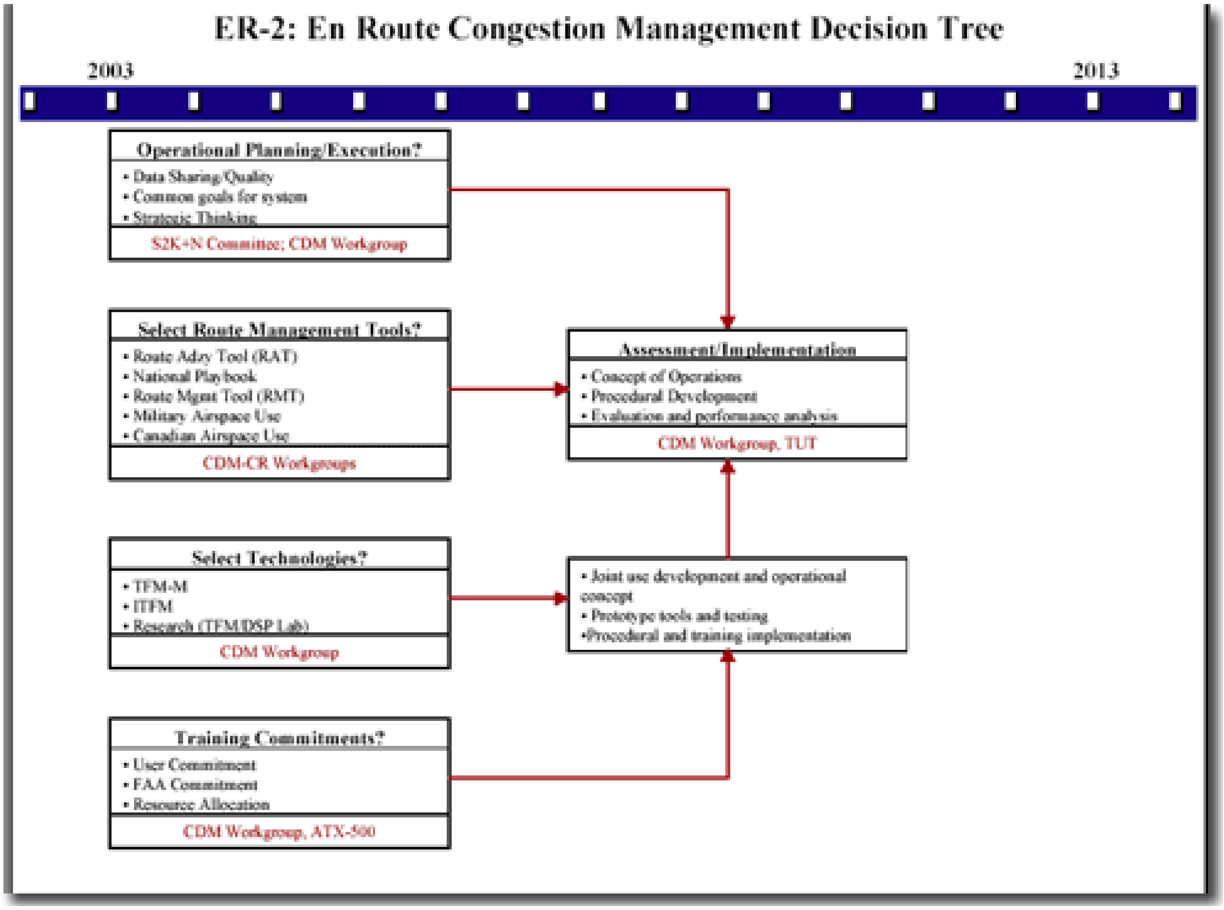
### Key Decisions

- Providing resources and ensuring maximum participation for joint FAA/User training.
- Site availability for training due to security condition.

### Key Risks

Resources, both internal and external to the FAA organizations

### Decision Tree




[View enlarged decision tree]

### Responsible Team

***Primary Office of Delivery***
Jack Kies, ATT-1

*Support Offices*
ATP-1
AOZ-1
AUA-700
ATX-500

***Other Websites***
[Relationship to the Architecture]

## ER-3
## Reduce Voice Communication

A significant portion of the controller workload is voice communications with the pilots. Application of selective communications services over controller-pilot data link communications reduces the use of en route voice communications. This change frees controller time and makes better use of the voice frequencies resulting in higher sector productivity, and an ability to accommodate the projected growth.

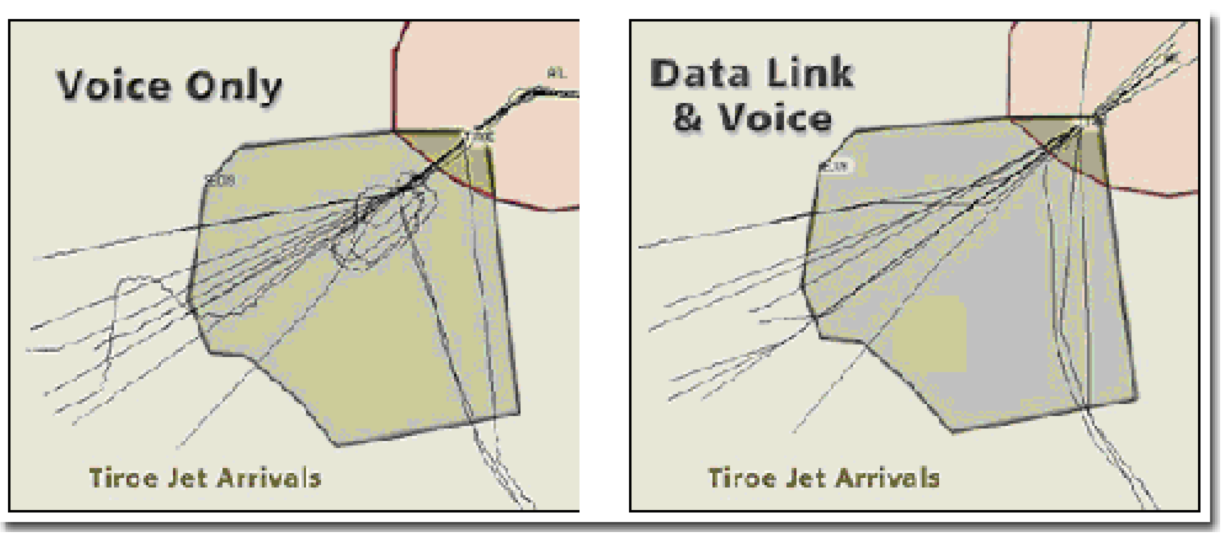
**Key Activities:**

| | |
|---|---|
| CPDLC Build 1A National Deployment Plan | 2004 |

**Smart Sheet:**
**Version 5.0, December 2002**

**ER-1: Match Airspace Design to Demands**

**Reduce flow constraints by reducing voice communications workload.**




**Background**

Pilots and radar controllers work together through voice communications to manage the flow of air traffic through the NAS in a safe and efficient manner. Structured sets of phrases have been developed for exchanging information and clearances, and for making requests. Standard phraseology is used to mitigate some of the limitations of oral communications. Communications between pilots and controllers often involve the exchange of routine information that is repeated for most aircraft entering or exiting a sector.

From a safety perspective, the primary sources of communication problems between controllers and pilots include: acoustic confusion; transposition of alphanumerics; “read-back” and “hear-back” errors; overlapping or simultaneous transmissions; misinterpretation caused by poor pronunciation; failure to use standard phraseology; manual data entry errors; and improper or malfunctioning radio keying operation. These communication failures contribute to a significant percentage of operational errors as well as reducing overall NAS efficiency.

As demand for access to the NAS increases, sectors shrink and the number of potential trajectory conflicts increase causing the controller-pilot communications burden to increase at a faster rate. In addition, the clearances needed for flexible routing, congestion management, and weather avoidance necessitate the exchange of complex route information between controllers and pilots not easily supported by oral communication. The provision of air traffic services via the use of data communications is a key means of addressing the safety, efficiency, and capacity constraints of the current voice communications-based NAS.

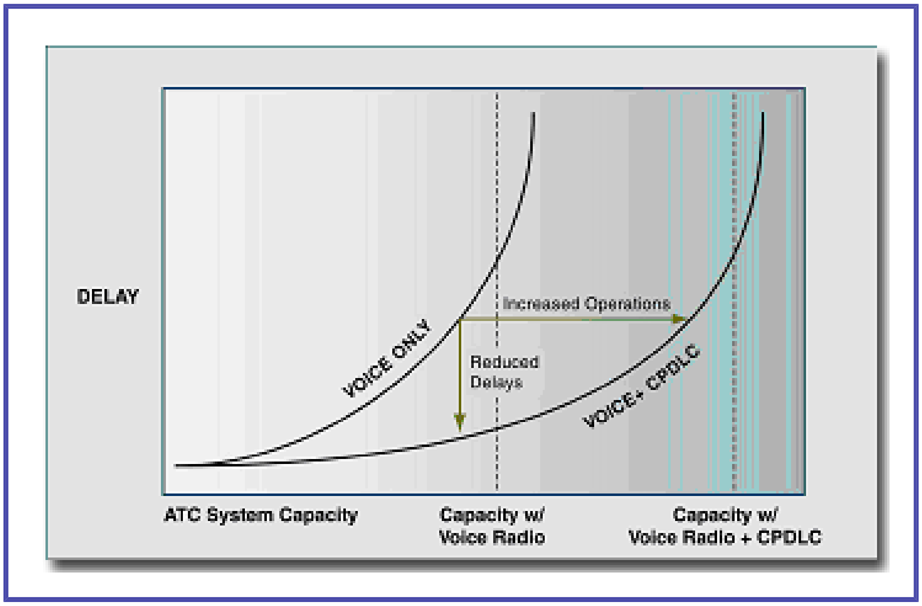
### Ops Change Description

One of the key operational changes to reduce voice communication workload underway in the domestic en route environment is the use of the Aeronautical Data Link System (ADLS). ADLS has as its leading application Controller-Pilot Data Link Communications (CPDLC). CPDLC provides the capability to display air traffic communications exchanged between the controller and the flight deck, thereby reducing the dependence on voice communications. CPDLC, specifically Build 1, is also intended to serve as the lead application in the evaluation of the Aeronautical Telecommunication Network (ATN) architecture. Build 1 IDU occured on October 7, 2002, with a National Deployment Plan for an expanded CPDLC capability (Build 1A) expected during 2004. Future implementations of data link in En Route airspace (CPDLC Build 1A) will expand the services available with the following 9 services: Initial 4 Services from Build 1, plus, Assignment of Speeds, Headings, Altitudes, Pilot-initiated Altitude Requests, and Route Clearance Function. Within a short period after IDU for Build 1A we expect to add another downlink request, pilot-initiated route requests.

### Benefit, Performance and Metrics

Reduced voice communications workload and distributed communications responsibility combine to provide the following benefits. Note that benefits increase as user equipage increases:

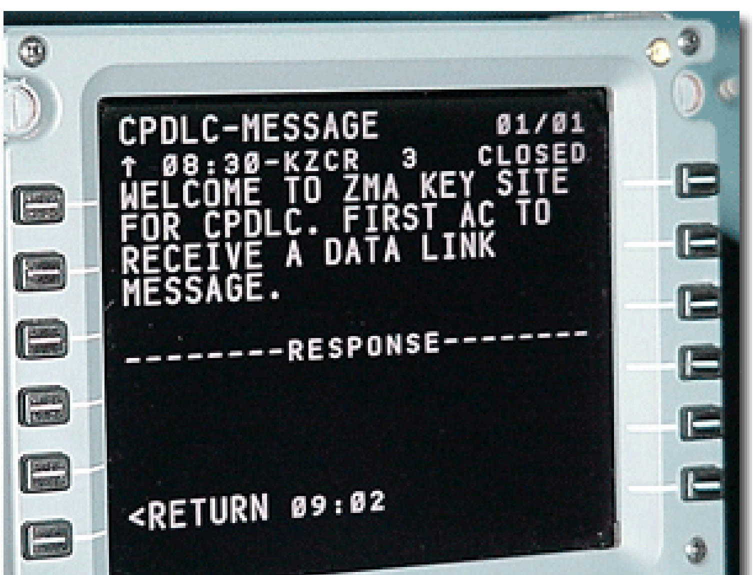
- Enhanced safety reflected by decreased operational errors and increased communications accuracy.
- Increased flight efficiency reflected by less time and fewer miles flown in sector (CPDLC reduces frequency congestion, therefore allows more timely and efficient delivery of clearances).
- Increased airspace capacity reflected by increased sector traffic throughput (miles in trail restrictions relaxed in an experimental sector based on voice communication reduction) and reduced delay (see chart below).




*FAA, User Benefits of Two-Way Data Link Air Traffic Control Communications Aircraft Delay and Flight Efficiency in Congested En Route Airspace.*
*FAA, Benefits of Controller-Pilot Data Link ATC Communications in Terminal Airspace.*

- As CPDLC evolves and is implemented nationwide, there are complimentary benefits to OEP objectives: ER-1, Matching Airspace Design to Demands; ER-4, Reducing Vertical Separation; ER-7, Accommodation of User Preferred Routing. These and any other objectives that may increase the need for communications within the NAS, will see their benefit increased with the availability of CPDLC.

### Scope and Applicability




First CPDLC message sent from ground to aircraft

- CPDLC is intended for use in En Route airspace and requires a commercially provided digital air-ground infrastructure. Airspace users require proper equipage to use the service. TheFAA does not intend to mandate CPDLC equipage.
- Customer demand and equipage will drive service coverage and benefits.
- Initial data link (CPDLC Build I) will be evaluated at Miami Air Route Traffic Control Center (ARTCC) starting in 2002 with the following four services: Transfer of Communication, Initial Contact, Altimeter Setting, and Predefined Instructions via Menu Text.
- CPDLC Build 1A, the next implementation of data link in En Route airspace, will expand the services available with the following nine services: initial four services from Build 1, plus, Assignment of Speeds, Headings, Altitudes, Pilot-initiated Altitude Requests, and Route Clearance Function. Within a short period after IDU for Build 1A, we expect to add another downlink request, Pilot-initiated route request.

  Future implementations of CPDLC will bring expanding messaging capability, enhanced security features, and integration of CPDLC into the terminal and ground communication environments.

## Key Dates

| | |
|---|---|
| OT&E and SAT complete at ZMA | 3/2002 |
| First CPDLC message sent from ground to aircraft | 3/2002 |
| First American Airlines test flight w/ CPDLC ground system | 4/2002 |
| ZMA Airway Facilities training complete | 6/2002 |
| American Airlines B757 aircraft CPDLC Cert/Ops Approval | 9/2002 |
| American Airlines B767 aircraft CPLDC Cert/Ops Approval | 10/2002 |
| ZMA Air Traffic Controller training complete | 9/2002 |
| CPDLC Build 1 IDU at ZMA | 10/2002 |
| CPDLC Build 1A Deployment Plan | 2004 |
| CPDLC Build 1 Evaluation @ZMA | 2002 |
| CPDLC Build 1 IDU Decision | 10/2002 |

## Program Status

- Since March 2002, WJHTC aircraft have logged ~75 hours of flight testing with Rockwell Collins and ARINC AOA/ATN, with ~5,000 messages exchanged, ~ 50 hours of ground/airborne testing with Rockwell Collins and FAA CPDLC end systems, ~1,000 CPDLC messages exchanged.

- American Airlines (AAL) equipping B-767 and B-757 (16+) aircraft to participate in Build I operations in the Miami ARTCC.
- Commitment from Delta Air Lines and their avionics provider Teledyne Controls to participate in Build 1 operations in Miami ARTCC airspace. Revenue CPDLC flights scheduled to begin in early 2003. The United States Air Force has also committed to participation in CPDLC activities in 2003.
- Continental Airlines, and Fed Ex all currently have plans for equipping aircraft for CPDLC Build 1 operations in Miami.
- CPDLC Build 1A ground system level requirements have been baselined. The system design architecture proposed by the development contractor is currently under review by the FAA.

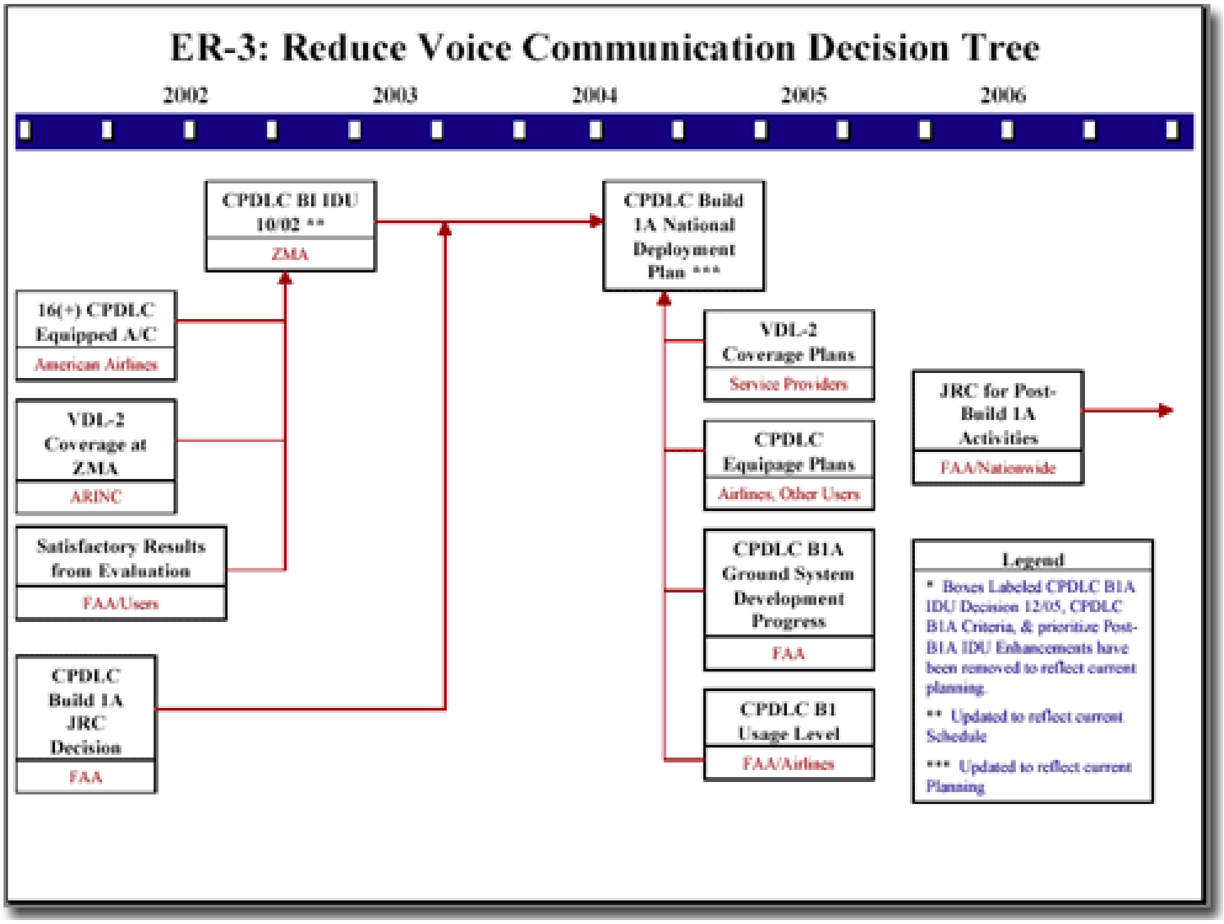
### Key Decisions

- CPDLC National Deployment Plan. In 2004, the FAA will make the national deployment decision in collaboration with industry. Replanning is underway as a result of recent development issues and to factor the success of Build 1 in Miami into the decision. The decision will depend on CPDLC Build 1A development progress and a firm commitment/plan of equipage by the airlines. The FAA will not mandate equipage for CPDLC. Additionally, adequate coverage of the VDL-2 network will continue to be a factor.
- Post Build 1A Evolution. CPDLC activities beyond Build 1A are not funded until 2007. The program requirements, cost, benefits, and schedule will Be evaluated and baselined in 2005.

### Key Risks

- System elements developed independently by stakeholders (e.g., FAA, ATN software vendors, avionics manufacturers, commercial communications service providers, and other air traffic service providers) must be interoperable.
- VDL-2 coverage of the NAS drives benefits. CPDLC communications will not be effective unless VDL-2 coverage is available across a significant portion of the NAS in order to make equipage cost-effective. If coverage is insufficient, users may not equip, controllers may not be able to use the capability fully, or FAA may not deploy to certain geographical areas.
- Experience is limited in the certification of cooperative air-ground systems. There is a need to acknowledge and credit the use of legacy and COTS systems and software in the end-to-end certification process. Furthermore, a change in the NAS automation architecture, e.g. Host to ERAM, could impact the certification level of CPDLC. A DO178B or DO278 treatment for design assurance for FAA ground systems will have a tremendously negative impact on the FAA’s ability to enhance its ground infrastructure and/or to spiral additional functionality for new air traffic tools. Use of DO178B or DO278 basically would freeze the infrastructure and/or capabilities in place; or, it would require the FAA to spend millions of additional dollars to move forward and to retain the current level of design assurance
- CPDLC represents a significant change in the human factors in the cockpit and the sector team and their interaction. This will require attention to ensure successful implementation. Increased planned prototyping and human-in-the-loop simulations at the early stages of the program will be designed to mitigate this risk.

### Decision Tree




View enlarged decision tree

## Responsible Team

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John Thornton , AOZ-1

***Support Offices***
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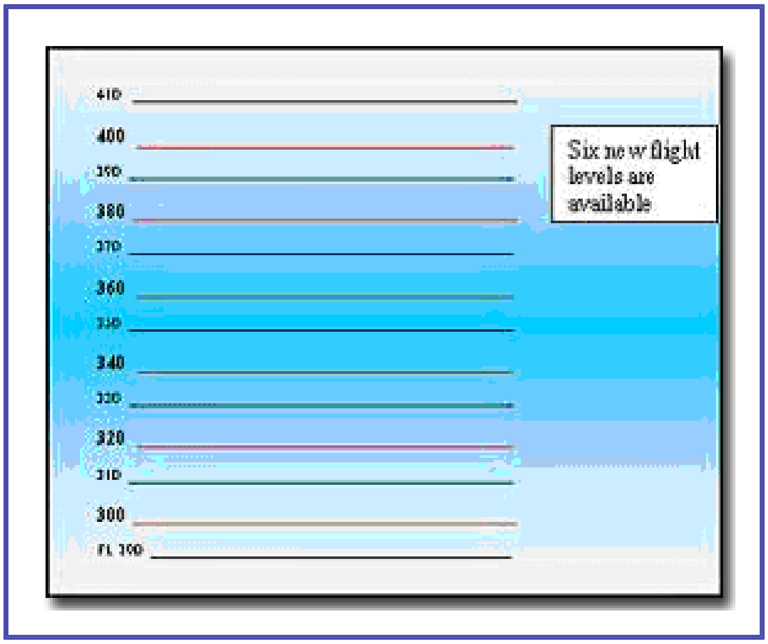
AUA-200
AIR-100

***Working Forums***
RTCA

***Other Websites***
Relationship to the Architecture
ER-3 Links To Architecture
Air Traffic Services / ATC-Separation Assurance / Aircraft to Aircraft Separation Capability
102113 - Reduced Routine Workload And Increase Efficiency By Improved Messaging - Demonstration
102114 - Reduced Routine Workload And Increase Efficiency By Improved Messaging - National
102115 - Increased Flexibility And Safety - Strategic Messaging

RTCA Website
Free Flight Program Office

## ER-4
## Reduce Vertical Separation




Implementation of the Reduced Vertical Separation Minimum (RVSM) between 29,000 and 41,000 feet (flight levels FL 290 and FL 410) will add six additional flight levels. This will provide benefits to the users and Air Traffic Control. Effectively reducing delays and contributing to time and fuel savings for the vast majority of users. In addition not only will this relieve enroute capacity constraints for the present, but for the medium to long term planning.

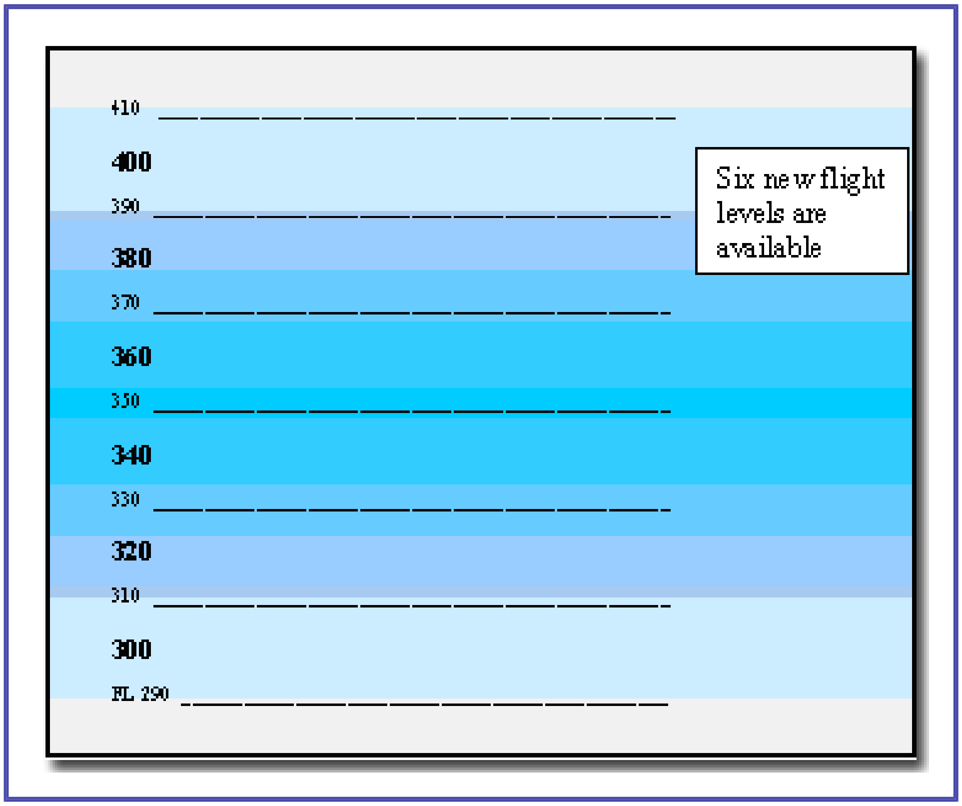
### Key Activities:

| | |
|---|---|
| Publish Final rule | June 03 |
| Deploy monitoring systems to assess aircraft altitude keeping performance | June 03 |
| Safety analysis review | June 04 |
| NAS Automation modifications complete | December 03 |
| Track fleet readiness in Database against implementation goals | January 05 |
| Proposed Implementation FL290-410 | January 05 |

### Smart Sheet:
### Version 5.0, December 2002

### ER-4: Reduce Vertical Separation 11/402 Update

**Reduce vertical separation minima to 1,000 feet for flights operating between 29,000 feet and 41,000 feet.**




## Background

In US domestic airspace 1,000 foot vertical separation is applied up to FL 290 and 2,000 foot vertical separation is applied above FL 290. The Reduced Vertical Separation Minimum (RVSM) program allows 1,000 foot vertical separation to be applied between FL 290 – 410 (inclusive). RVSM was initially implemented in the North Atlantic (NAT) between FL 330-370 in March 1997. It was implemented in Pacific oceanic airspace between FL 290-390 (inclusive) in February 2000. RVSM is now implemented in the NAT, Europe, the New York Oceanic FIR portion of the West Atlantic Routes System and Australia between FL 290-410 (inclusive). (A map showing RVSM implementation status in individual areas of the world can be viewed on the FAA RVSM website discussed below).

Aircraft that have complied with FAA RVSM standards are eligible to conduct RVSM operations worldwide with the exception that if a single altimetry system is adopted, those aircraft will be restricted to U.S. domestic airspace. The operator, however, must adopt operational policies/procedures specific to individual areas of operation prior to commencing RVSM operations in those areas. Approximately 30% of aircraft that operate in the US above flight level 290 were RVSM compliant as of August 2002.

The FAA maintains an RVSM website at www.faa.gov/ats/ato/rvsm1.htm. Specific information on FAA RVSM policy/procedures for aircraft and operator approval, air traffic control and monitoring can be found on that website.

## Ops Change Description

The objective is to implement RVSM in the vertical stratum of the airspace of the contiguous 48 States of the United States and Alaska and in Gulf of Mexico airspace where the FAA provides air traffic services (Houston and Miami Oceanic Flight Information Regions and Jacksonville Offshore Airspace).

## Benefits, Performance and Metrics

- *Fuel Burn Savings*. Fuel burn savings are projected to be approximately $5.8 billion over the 15 year period between 2004-2018. Fuel burn savings are estimated to be $371 million in the first year increasing at a rate of 1.5% per year. This amounts to an approximately 2% per cent savings for US domestic operations. Fuel burn savings are directly attributable to greatly improved performance of jet engines above FL 290, as well as improved routing, altitude selection, and reduction of delays provided by RVSM
- *Increased Flight Level Availability*. Makes six additional flight levels (for a total of 13) available for operations between FL 290-410. (Current FL orientation schemes applied between FL 290-410 provide seven useable FL's).
- *Airspace Capacity*. Provides potential increase in sector capacity by enhancing traffic throughput and efficiency within en route airspace.
- *Controller Flexibility*. Enhances controller flexibility. Provides more options for situations such as weather re-routes and crossing traffic.
- *Controller Workload*. Reduces controller work load.
- *Conflict Points*. Diminishes the effect of traffic converging at critical points in high density traffic areas.
- *Enhanced Predictability*. Enhances predictability of operations by increasing the flight levels available to move aircraft allowing more aircraft to fly at requested flight level.
- *Delays*. Provides potential to reduce departure delays.

## Scope and Applicability

The Domestic Reduced Vertical Separation Minimum (DRVSM) Team has held meetings with user advocate groups and DoD. Such meetings will continue to be scheduled periodically to inform and obtain feedback from users. Also, RVSM seminars are being held to educate users and FAA field offices on RVSM program requirements. (See the FAA RVSM website for seminar announcements and schedule).

- The proposal to implement RVSM between FL 290 - 410 (inclusive) on January 20, 2005 is considered to be a feasible option and the FAA is developing its plans accordingly.

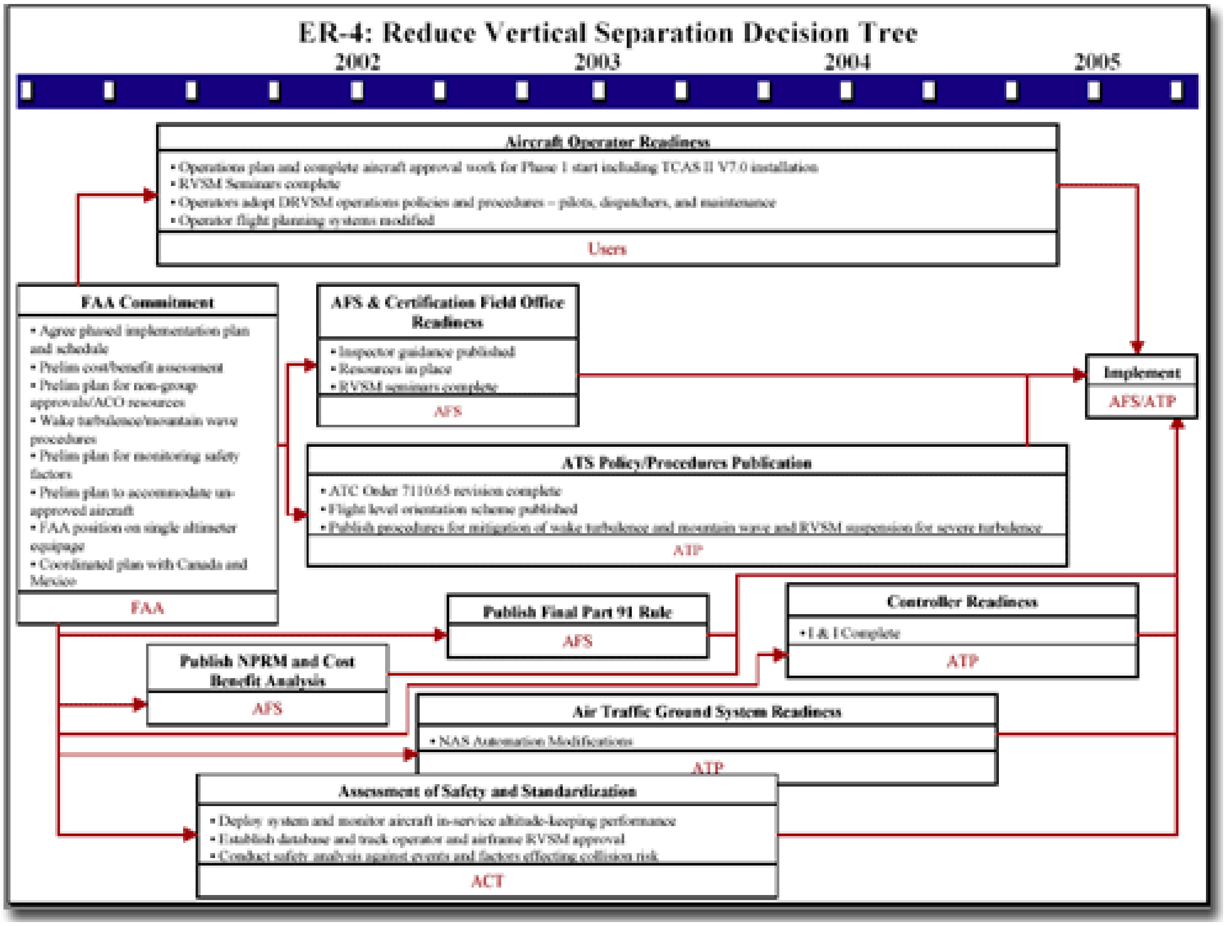
## Key Decisions

- Implementation dates and vertical stratum.
- Policy has been established for non-RVSM compliant DoD and air ambulance aircraft.
- Key Tasks and Risks
    - RISKS
        - *Cost/Benefit and Implementation Schedule*. General user acceptance of an implementation plan and schedule that enables the significant majority of aircraft to be engineered to RVSM compliance. (ATP, AFS)
        - *Operator Fleet Readiness*. Operators must complete required aircraft and operator approval actions in the period leading up to implementation (AFS,

AIR).Failure of Operators to accomplish these actions by a significant number could result in program delay.

- TASKs
  - Implementation of procedures to transition non-RVSM aircraft to climb and descend through RVSM airspace to operate at and above FL430. Rulemaking. FAA published an NPRM in May. The 90-day comment period ended on August 8. The Final Rule is scheduled for publication in June 2003.
  - *Accommodation of Un-Approved Aircraft*. Acceptance of policies for accommodation of non-RVSM approved DoD and air ambulance aircraft (ATP, AFS).
  - *Wake Turbulence/Mountain Wave Effects*. Development of procedures to mitigate the effect of wake turbulence and mountain wave effect (ATP, AFS).
  - *Flight Standards Field Resources*. Development of plans for Flight Standards field office approval of large numbers of aircraft and operators (AFS).
  - *Aircraft Certification Office Resources*. Development of plans for Aircraft Certification Office resources to approve individual unique (non-group) airframes for RVSM (AIR, AFS). *Note*: We have established a memorandum of understanding with DoD to accomodate their aircraft in domestic US RVSM airspace.
  - *Coordination with other Air Traffic Service providers*. Coordination of implementation plan with Canada, Mexico and ATS providers in the Caribbean and South America. (ATP, AFS, ACT).
  - *Safety Analysis*. Acceptability of safety analysis to support the DRVSM implementation decision (ATP, AFS, ACT).
  - *TCAS Version 7.0*. Aircraft equipped with TCAS II and used in RVSM operations will be required to equip with, Version 7.0 (or a later version) in accordance with part 91 Appendix G. (TCAS equipage is not required for RVSM operations. TCAS equipage requirements are published in regulations not related to RVSM).
  - *NAS Modification*. Modify NAS capabilities such as conflict alert to make them effective at FL's above 290 where 1,000 ft vertical separation is applied. (ATP).
  - *Pre and Post Implementation Monitoring*. Pre- and post implementation monitoring program to assess key factors related to operational safety: data base of approved operators/aircraft; system to monitor aircraft altitude-keeping performance (AFS, ACT).
  - *Airspace Re-Design*. Coordinate DRVSM program with High Altitude Airspace Re-design Program (ATP, ATA).

### Decision Tree




View enlarged decision tree

## Responsible Team

***Primary Office of Delivery***
James L. Ballough, AFS-1
Robert Swain, AFS-400
Lead Specialist: Flight Technologies and Procedures Division

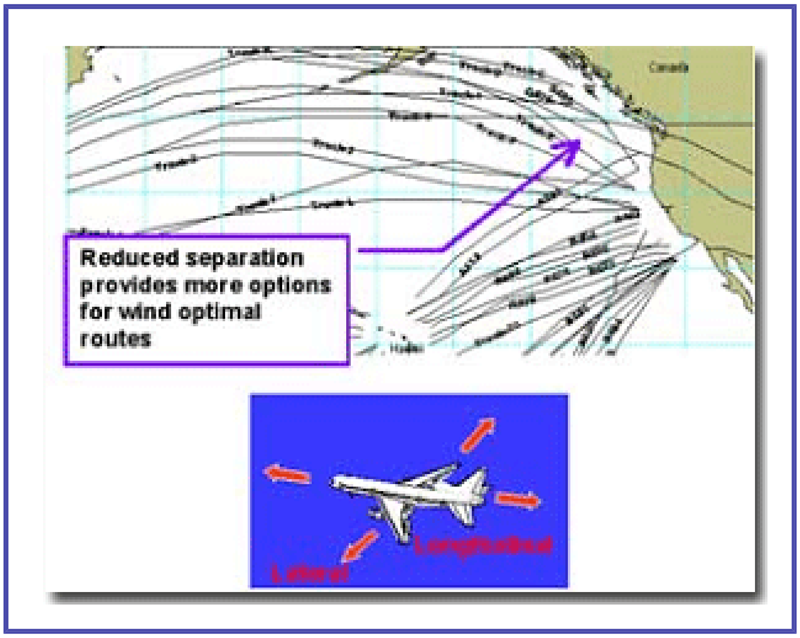
***Support Offices***
Avionics System Branch: AIR-130
Enroute Operations / Procedures: ATP-110
NAS & International Airspace Analysis Branch: ACT-520
Automation: AUA-200

***Working Forums***

***Other Websites***
Relationship to the Architecture

## ER-6

## Reduce Oceanic Separation




Transoceanic flights are confined to airspace based on separation standards that are defined for manual surveillance and unreliable communications. Allowing properly equipped aircraft to operate at reduced oceanic separation will enable more aircraft to fly optimal routes, enhancing aircraft time efficiency in the oceanic leg of their flight. Reduced separation laterally may provide space for additional routes to current destinations or new direct markets. Reduced longitudinal (nose-to-tail) separation will provide more opportunity to add flights without a delay or speed penalty.

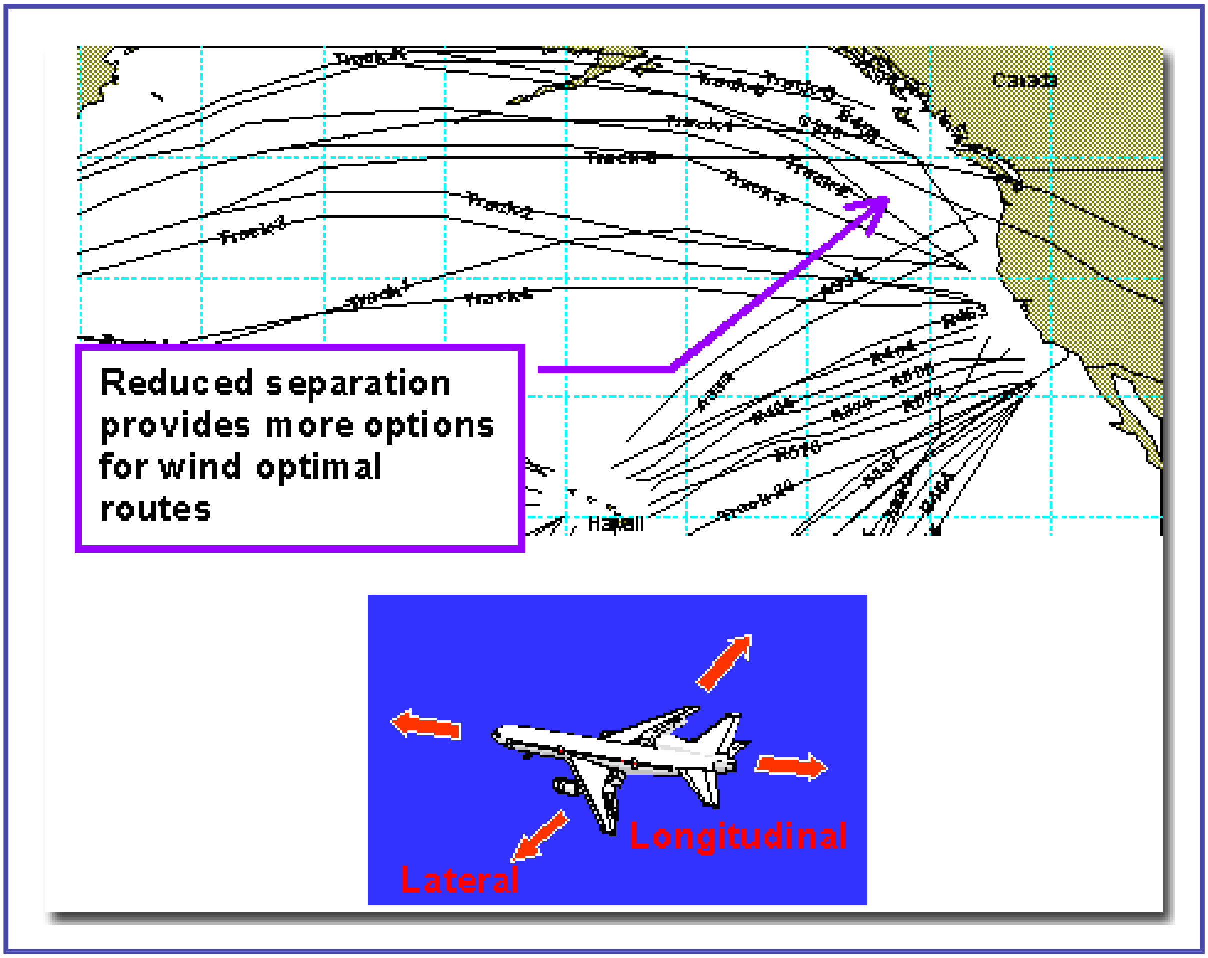
### Key Activities:

| | |
|---|---|
| ATOP IOC at Oakland | 4/03 |
| ICAO Regional Procedures and Guidance | 11/03 |
| ATOP Build II at Oakland | 11/04 |

**Smart Sheet:**
**Version 5.0, December 2002**

### ER-6: Reduce Oceanic Separation

**30 nm lateral and longitudinal (30/30) separation in the ocean.**




## Background

- *Separation Standards Factors*. Separation standards in a given airspace are a function of the communication, navigation, and surveillance capabilities available in a specific operating environment. Safety analysis and operational judgment consider factors such as: timeliness and reliability of controller-pilot communications, accuracy of aircraft navigation, the controller's ability to determine potential separation loss, aircraft traffic density, and procedures for contingencies such as engine failure and weather deviations.
- *RNP Concept*. The Required Navigation Performance (RNP) concept has been introduced in Pacific operations to standardize navigation. For example, RNP-10 approved aircraft are equipped with navigation systems that can navigate within 10 miles of desired position with 95% probability.
- *Current Separation Standards*. Currently, the minimum lateral separation applied by the FAA is: 120 nm in Atlantic and Caribbean/South American airspace, 60 nm in North Atlantic minimum navigation performance specification airspace, 50 nm between RNP-10 approved aircraft in Pacific airspace except in the Central Pacific where, due to convective weather, 100 nm lateral is applied south of 30N.
  Conventional longitudinal separation is 10 minutes (approximately 80 nm). 50 nm longitudinal separation is currently applied by South Pacific air traffic service providers having enhanced CNS/ATM systems, to aircraft approved for direct controller-pilot communication via voice or data link and RNP-10 (10 nm/95% probability). In the FAA's oceanic airspace, communication service is currently a FANS 1/A system.
- *Current Deployment of ADS-A Systems*. Air Traffic Service Providers in New Zealand, Australia, Tahiti, and Fiji use FANS 1/A Automatic Dependent Surveillance-Address (ADS-A)

systems in Pacific oceanic airspace. In addition, a similar system is under operational testing in Tokyo oceanic airspace.

- *Status of Aircraft System Approvals*. The FAA and other civil aviation authorities have certified ADS-A, CPDLC and RNP capabilities on aircraft such as the B-747-400, B-777 and the A-340.

### Ops Change Description

30/30 Separation. The ICAO Separation and Airspace Safety Panel has established standards for the implementation of 30 nm lateral and longitudinal separation that call for: direct controller-pilot communication via voice or datalink, aircraft navigation accuracy to RNP-4 (4 nm/95% probability) and ADS-A capability in the aircraft and at the oceanic center.

FAA ADS-A/ATOP Program. The Advanced Technology and Oceanic Procedures (ATOP) program will deploy ADS-A capability in airspace where the FAA provides oceanic air traffic services. FAA oceanic centers currently offer direct controller-pilot communication via data link + to equipped aircraft.

The ATOP system will enable the application (to properly equipped aircraft) of 50 nm longitudinal separation (extended use) and 30 nm lateral and longitudinal separation. These reduced separation standards will increase oceanic airspace capacity and aircraft time/fuel burn efficiency. ATOP will also improve the safety of oceanic operations by giving controllers enhanced tools to track aircraft progress and identify potential aircraft conflicts and problems.

### Benefits, Performance and Metrics

- *Fuel/Time Savings.* Provides equipped users with fuel and time savings, more reliable and optimum routes and greater likelihood of timely granting of requests for clearance changes.
- *Flown as Filed.* Percentage of flights cleared as filed will increase. As a result, fewer altitude change or speed commands are needed because of the pilot’s ability to maintain spacing and the smaller separation “bubble” required around each aircraft.
- *Route Efficiency*. The number of routes moved closer to great circle or minimal wind route is expected to increase, resulting in the reduction of fuel load as route reliability increases.
- *Step Climbs*. Increase in user requests granted for procedures such as step climbs.
- *Safety Benefit/Collision Risk Reduction.* Enhanced ATOP surveillance capabilities combined with direct controller-pilot communication via voice or data link will enable controllers to detect and intervene when aircraft deviate from cleared track or altitude and mitigate the risk of conflict with other aircraft.

### Scope and Applicability

- *Enhanced Surveillance in FAA Controlled Oceanic Airspace*. ADS-A will provide enhanced surveillance capability in Oakland, Anchorage, and New York oceanic airspace. ADS-A will enable the FAA to apply 30 nm lateral and longitudinal separation in that airspace.
- *Initial Goals/Dates*. Initial FAA goals are to implement 30 nm lateral and longitudinal (30/30) separation in Oakland controlled South Pacific airspace by 2005.
- *Medium to Long Term*. As ADS-A deployment progresses and as more aircraft become RNP-4 capable and approved, use of 30/30 separation will be expanded beyond the South Pacific. In

the period 2006-2013 it is expected that 30/30 will be utilized throughout the Pacific and potentially in the North Atlantic airspace controlled by New York ARTCC.

- *Aircraft Fleet Equipage*. 30/30 separation and enhanced surveillance will only apply to appropriately equipped aircraft. Aircraft system requirements for 30/30 include direct controller-pilot communication via voice or data link, RNP-4 approval, and ADS-A.
- *Contingency Procedures*. Contingency procedures will be developed for loss of communications, ADS-A or aircraft RNP-4 capability, aircraft system malfunctions, and weather deviations.

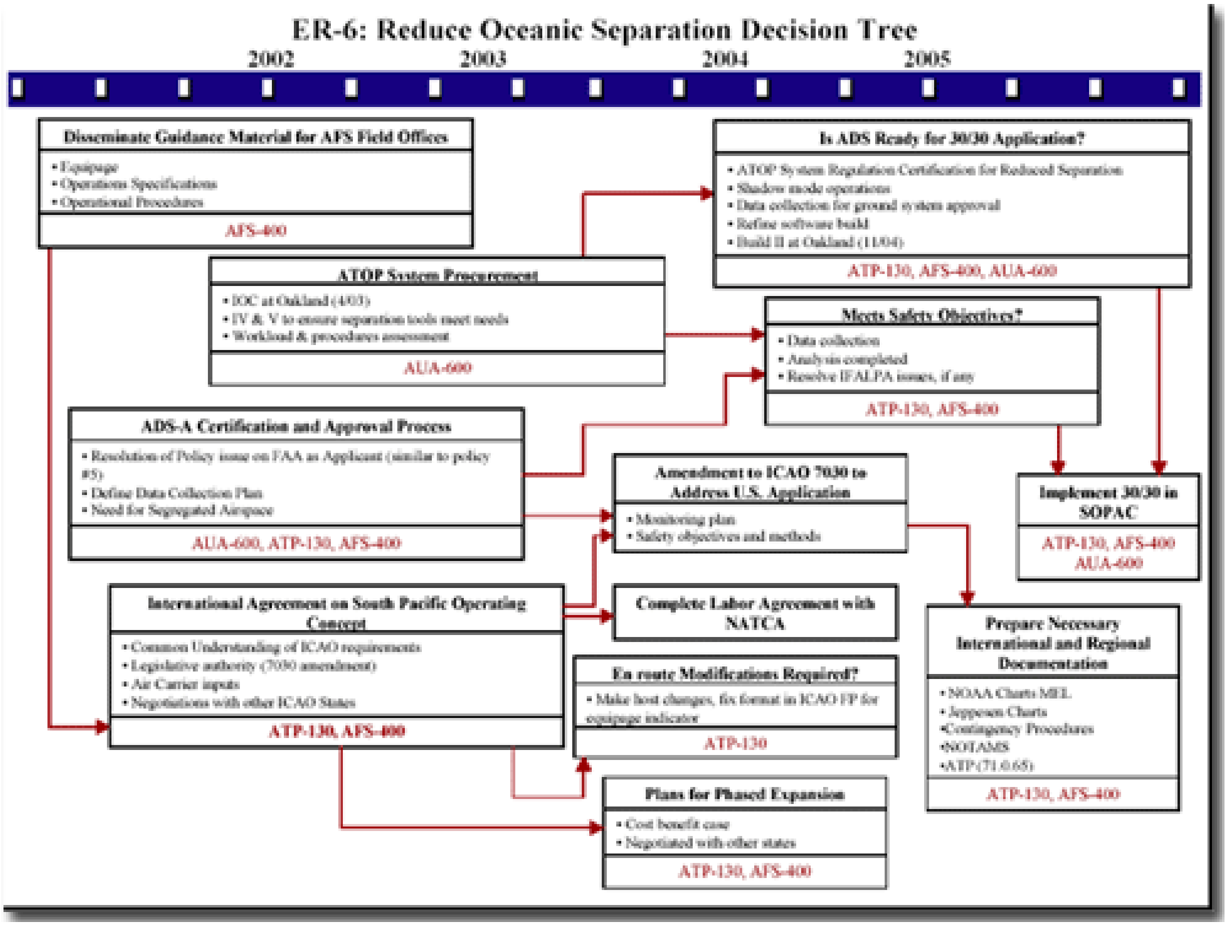
## Key Decisions

- *Cost/Safety Benefits*. Operator decision to increase levels of aircraft equipage, based on cost/benefit and safety enhancements gained by ATOP deployment.
- *Aircraft Fleet Equipage*. To maximize benefits, aircraft fleet equipage with direct controller-pilot communication via voice or data link, RNP-4 and ADS-A capabilities must increase significantly. (Currently approximately 30% of oceanic flights are so equipped.)
- *Accommodation of Mixed Equipage time*. Decision on how to accommodate aircraft with mixed CNS capabilities for an extended period of time must be developed and accepted.

## Key Risks

- *ADS-A System Deployment*. ADS-A system must progress without significant delay to IOC and Build II at Oakland ARTCC.
- *ADS-A System Performance*. ADS-A system must perform at prescribed levels of reliability and availability
- *ATOP Deployment*. ATOP must be deployed on time.
- *Staff Resources*. Adequate experience and staffing levels to support national and local procedures development, operator approval, and transition of systems for the separation standards in ocean and remote areas.
- *AFS Resources*. Availability of Flight Standards specialist resource to assess ADS-A system performance and capability to mitigate collision risk and enable aircraft separation reduction.
- *30/30 Implementation Requirements*. Acceptance of adequacy of 30/30 implementation requirements such as safety analysis, ground and aircraft capabilities, and contingency procedures.
- *Operator Commitment to Aircraft Equipage*. Cost/ benefit and safety analysis to advocate fleet advanced CNS equipage beyond current approximate 30% level.
- *Revision of ICAO Regional Policy Documents*. Publication of 30 nm lateral and longitudinal standards in ICAO Asia and Pacific Regional Supplementary Procedures.

## Decision Tree




View enlarged decision tree

### Responsible Team

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AFS-400, John McGraw
AIR-100, Steve VanTrees

***Working Forums***
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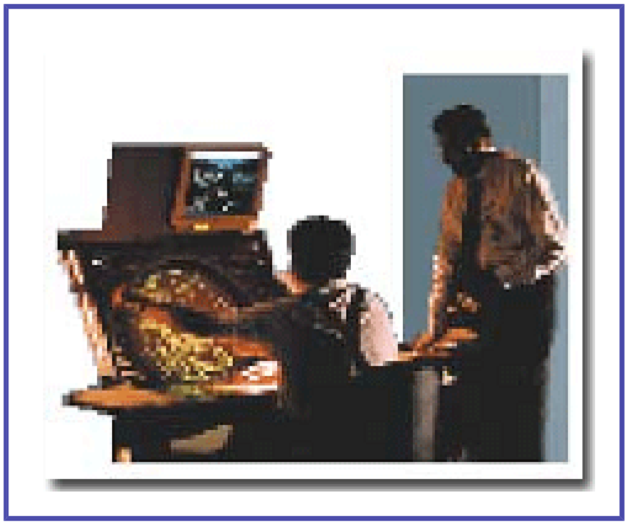
***Other Websites***
Relationship to the Architecture
http://www.faa.gov/ats/ato/130.htm

## ER-7
## Accommodate User Preferred Routing



Today, controllers have a view of the airspace that is bounded by the sector that they control. Fixed airspace structures used to organize flows and create predictable intersections are necessary for moment-to-moment control. These structural limitations in some cases result in under utilization of some airspace even as adjacent airspace may be congested. A more strategic look across multiple sectors with conflict detection tools and the flexibility granted the users in the national route program should decrease the concentration of flights. However, in some cases the structure may actually enhance the efficient use of airspace. A careful balance of sufficient, predictable flows and controller look-ahead is required to ensure that flexibility does not simply shift the point of congestion to other sectors.

### Key Activities:

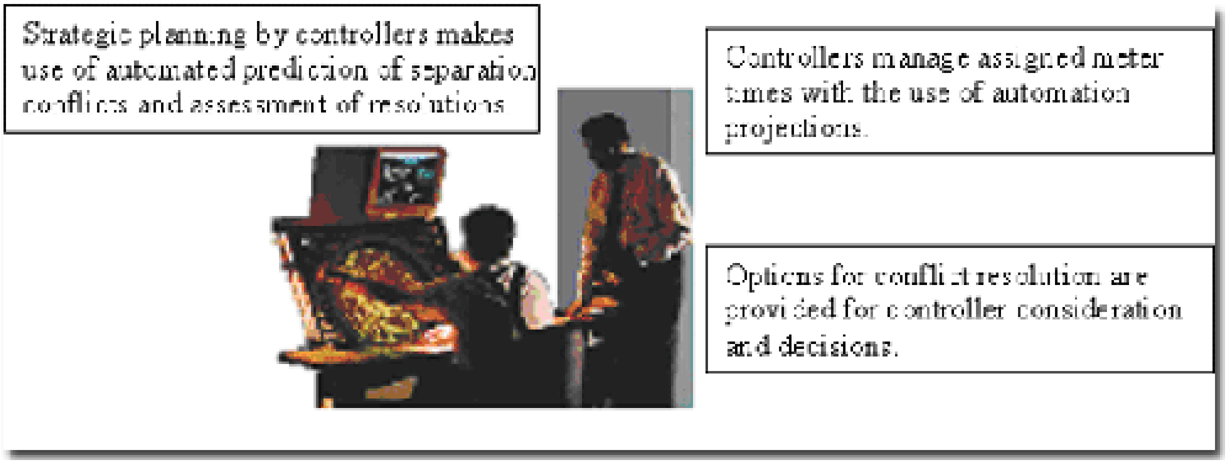
| | |
|---|---|
| Deployed URET at Six FFP1 Sites | 2002* |
| Comprehensive Revisions to Restrictions (Ongoing) | 2003 |
| Deploy URET to 4 additional sites | 2003 |
| Evaluate PARR | 2004 |
| Evaluate D2 | 2004 |
| Deploy URET to the 10 remaining sites | 2004** |
| Evaluate EDA | 2005 |

*URET deployed at ZTL during FFP!; however, a local staffing issue has kept it from going operational (IDU).

### Smart Sheet:
### Version 5.0, December 2002

### ER-7: Accommodate User Preferred Routing

**Optimize airspace use by providing decision support tools to users and service providers.**




## Background

Today, controllers have a view of the airspace that is bounded by the sectors for which they have jurisdiction. This view limits the options available to the controller to solve problems. In addition, a fixed route structure is used to organize the airspace, providing controllers with predictable points where conflicts may arise. This fixed route structure allows controllers to maintain a three-dimensional view of the traffic situation. In some cases, however, this results in aircraft being separated from airspace. In the current environment, flow constraints (e.g., Miles-in-Trail restrictions, ground delay programs, re-routes) are used to avoid situations where the number of aircraft being controlled by an en route sector controller is beyond the controller's ability to provide separation services. This also results in the users being constrained in their choice of flight paths.

## Ops Change Description

By providing Air Traffic Management decision support capabilities to the sector, controllers are able to see beyond their own sector boundaries allowing some long standing restrictions to be removed, increasing the options to solve problems as well as increasing the likelihood that more efficient services can be provided. This will be accomplished through the addition of strategic management tools that complement the tactical control techniques used to maintain safety. These strategic tools provide advisory information about routes and/or altitude options that can avoid conflicts and weather situations. The specific decision support capabilities are:

- **ER-7.1:** *Conflict Identification and Planning*, which assists controllers in the prediction of aircraft-aircraft and aircraft-airspace conflicts and which has capabilities for controllers to construct and assess alternatives. The User Request Evaluation Tool (URET), being developed and deployed under Free Flight Phase 1 and 2, will provide these capabilities.
- ER-7.2: *Metering and Merge Planning*, which provides a metering plan to TMCs and provides information to controllers to quantify the differences between assigned meter times and the times that aircraft are projected to cross a meter fix. The Traffic Management Advisor (TMA), being developed and deployed under Free Flight Phase 1 and 2, will provide these capabilities at some locations. An enhanced version of TMA, to optimize arrival traffic management spanning multiple ARTCCs is currently in research. Although TMA is cited also under AD-4, it is included here to emphasize its role in optimizing airspace utilization.
- **ER-7.3:** *Conflict Resolution and Planning Aids*, which are used by controllers to generate proposed solutions to aircraft-aircraft and aircraft-airspace conflicts and to identify instances where a more direct route will result in user savings. A resolution capability - Problem Analysis, Resolution, and Ranking (PARR) and a direct routing aid - Direct-to (D2) are

currently being researched. D2 is also conflict detection and conflict resolution.
From the user perspective these capabilities will support their ability to fly routes that are defined by points in the airspace (latitude/longitude/altitude), with fewer restrictions caused by the structure of the airspace.

### Benefit, Performance and Metrics

- Reduction in static airspace restrictions (ER-7.1 and ER-7.3).
- The total miles flown through a center will decrease (ER-7.1 and ER-7.3).
- Hourly flow by ARTCC and Sector will be increased (ER-7.1 and ER-7.3).
- Fewer low-altitude holds will be invoked (ER-7.2).
- Fly as filed percentage (including altitude) will increase (ER-7.1 and ER-7.3).
- User-requested re-route percentage being granted will increase (ER-7.1 and ER-7.3).
- Airport peak operations rate will increase (ER-7.2).
- Reduction in departure delay for flights released by the ARTCC (ER-7.1, ER-7.2, and ER-7.3).
- More efficient delay distribution in transition airspace (ER-7.2).

### ER-7.1 Conflict Identification and Planning

Decision support tools assist the controller in detecting conflicts and assessing potential changes to the aircraft's path. Enhancements to Conflict Detection are being addressed by D2 research as well.

### Scope and Applicability

- URET can be applied to all en route airspace. The benefits URET provides depend on the traffic levels and complexity that sector controllers have to deal with. For greatest benefit, URET should be available in contiguous airspace.
- URET CCLD is deployed and operational at six centers (Cleveland, Chicago, Memphis, Indinapolis, Kansas City, and Washington ). Phase 1 URET deployment is complete.
- Next Step: FFP will expand URET to Minneapolis, Denver, Albuquerque, Fort Worth, Jacksonville, New York, Houston, Atlanta, Boston, Miami, Salt Lake City, Seattle, Oakland and Los Angeles centers. The FF Program Office will complete deployments prior to 2005, with initial daily use at four sites in FY 03 and ten sites in FY 04. URET will initiate efforts for integration with CPDLC.
- URET will be deployed nationally starting in FY03 without the Assisted Trial Planning-Coded Menus functionality. Assisted trial planning is a PARR research function and will be implemented in URET at the earliest in URET Build 4 in late FY04 or early FY05 if the function is prioritized by AT as a candidate for Build 4. If not, it would not be implemented until URET Build 5 in FY05 or later.

### ·Key Decisions

None identified.

### Key Risks

- The degree to which URET capabilities will be used operationally is dependent on the implementation of procedural and cultural changes.
- Interface with ongoing development of Traffic Management Initiatives.

### ER-7.2 Metering and Merge Planning

Decision support tools provide the TMC with a metering plan and the controller with information on the required delays for each aircraft (also see AD-4.1).

### Scope and Applicability

- TMA (Traffic Management Advisor) is applicable for airports where arrival demand regularly exceeds capacity.
- TMA-SC (Traffic Management Advisor – Single Center) near-term and mid-term locations include: ZFW-DFW (complete), ZMP-MSP (complete), ZDV-DEN (complete), ZMA-MIA (operational), ZOA –SFO (operational), ZLA-LAX (complete), and ZTL-ATL (operational). Transition to time based metering (TBM) is required to complete ZMA, ZOA, and ZTL. . Transition of these sites to TBM will be dependent on sufficient Back Fill overtime availability.
- Additional arrival sites will require site specific adaptation. FFP2 plans to deploy TMA-SC to support arrivals at the following airports: ZME-MEM(IDU 5/1/06), ZKC-STL(IDU 12/1/06), ZID-CVG(IDU 11/15/05), and ZHU-IAH(IDU 8/15/03). In FY03 FFP2 will deploy TMA-SC to ZHU-IAH. ZID-CVG, and ZME-MEM will be deployed in FY2006. ZKC-STL will follow in FY 2007. The facilities should be fully transitioned to time based metering 1 year after IDU. The transition, however will be dependent on sufficient Back Fill overtime availability.
- TMA-MC (Traffic Management Advisor – Multi Center) will enhance TMA to work in areas where the airport is close to the center boundaries and where arrival flows interact with flows to other airports. RTCA recommended TMA for several sites that require TMA-MC capability, these include Washington area airports, N90 airports, PHL, DTW, SDF, BOS, and PIT. NASA is developing TMA-MC with emphasis on PHL airspace; this capability will be evaluated in 4 ARTCCs and PHL TRACON in FY 2003 and 2004. TMA-MC will provide advisory information to controllers which is similar to that provided by TMA-SC, with the enhancement that the advisories are available to controllers in multiple ARTCCs. These distributed advisories collectively implement a coordinated plan for managing arrivals to a given airport.

### Key Decisions

- Priorities for TMA deployments beyond the current FFP2 Baseline.
- Investment decision to enhance TMA-SC baseline with TMA-MC functionality.

### Key Risks

- NASA is currently researching TMA-MC. Implementation is dependent on the success of this research and on NASA participation in technology transition.
- New York and Philadelphia redesign activities will result in changes to TMA adaptation and therefore work in these areas needs to be coordinated. Transition to use of metering tools

requires substantial facility commitment and resources for adaptation, procedural development, and training.

## ER-7.3 Conflict Resolution and Planning Aids

Decision support tools will assist the controller's ability to resolve conflicts and to generate direct routes.

### Scope and Applicability

- En route conflict resolution aids expand on the conflict probe capability provided by URET CCLD.
- Research is currently underway on a direct-to tool that identify instances where a more direct route will result in user savings and on conflict resolution aids that assist the controller in generating solutions. D2 evaluations are being conducted in phases, beginning in 2002 and continuing throughout 2003 and 2004. The initial focus has been on developing an operational concept for the use of D2 as an en route R-side controller conflict probe, trial planning tool, and flight plan amendment interface. Evaluations of D2 by the ATCP have resulted in an initial Ops Concept for an R-side D2 that is interoperable and complementary to the URET functionality on the D-side. Further evaluations are planned to flesh out this Ops Concept and derive the detailed requirements necessary to transfer D2 to the en route development contractors for integration into the NAS. A full investment analysis and deployment plan for D2 has not yet been developed; however, the most likely implementation scenario is for D2 to be integrated into the en route architecture as an ERAM Pre-Planned Product Improvement (PPPI).
- EDA has not yet completed the Technical Readiness Level 3 (TRL-3) criteria which trigger active FAA assessment of the tool. When EDA transitions from TRL 3 to TRL 4 (by NASA's schedule, in 2005), the FAA Free Flight office will engage NASA and a representative Air Traffic Controller user team to begin the evaluation and development of an FAA Ops Concept for EDA. As with all Free Flight R&D efforts, the Ops Concept will encompass EDA functionality as well as EDA's intended use in conjunction with other en route automation and decision support tools.

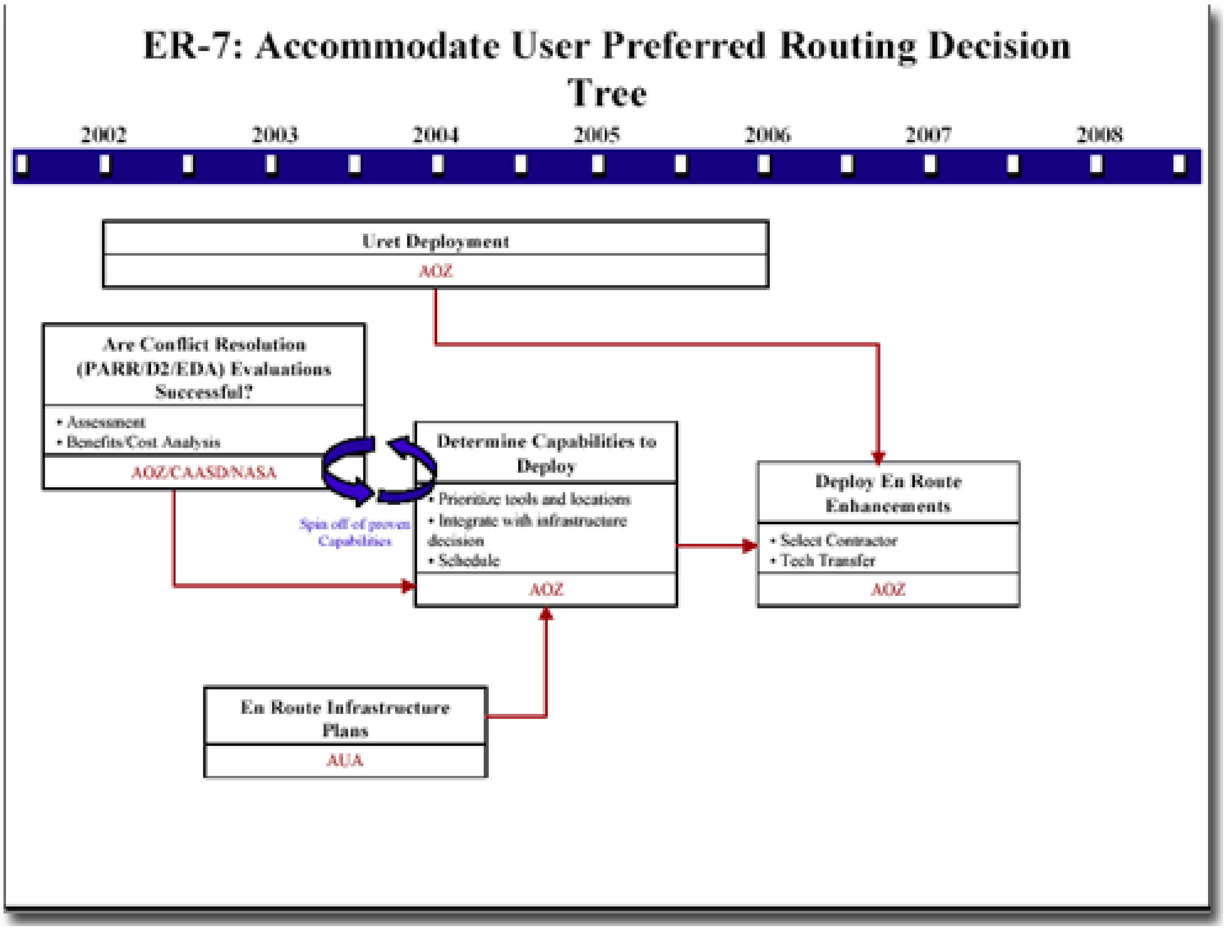
### Key Decisions

None identified.

### Key Risks

- MITRE/CAASD is currently researching conflict resolution aids (PARR - Problem Analysis, Resolution, and Ranking). Implementation is dependent on the success of this research and on CAASD participation in technology transition.
- NASA is currently researching a direct-to (D-2) capability. Implementation is dependent on the success of this research and on NASA participation in technology transition.
- Acceptance of automatically generated conflict resolutions may require procedural changes.

### Decision Tree




[View enlarged decision tree](#)

## Responsible Team

***Primary Office of Delivery***
John Thornton

***Support Offices***
ATP-1
AUA-200

***Working Forums***
RTCA
Interagency IPT

***Other Websites***
[Relationship to the Architecture](#)
RTCA Website
Free Flight Program Office

# Operational Evolution Plan
## En Route Hazardous Weather

## EW-1
## Integrate Weather Information into Traffic Flow Management

The disruptions in air traffic caused by hazardous en route weather are magnified by the lack of common understanding of weather information, and the intrinsic uncertainty of the forecast. There is a discrepancy between weather forecasts and the observed weather; there is a deficiency in the application of weather information to manage traffic flow in congested airspace. A commitment to operational change can be implemented by first improving the detection and forecasting of hazardous weather, although these improvements will be incremental. Secondly, the impacts of weather can be mitigated through improved distribution, display, training, and application of weather information. Finally, the integration of weather information into Decision Support Systems (DSSs) and automated tools will achieve the full potential for operational change by maximizing the capacity of the airspace and improving the efficiency with which the NAS is utilized, even during disruptive events of hazardous weather.

### Key Activities:

| | |
|---|---|
| Complete an Integrated Project Plan | 7/03 |
| Complete EW-1 plan and milestones | 9/03 |
| ATM/DSS Workshops | 1/03; FY04 |
| CDM Workgroup Report on Weather Applications | 1/03; 9/03 |
| Training Plan for Convective Products | 5/03 |
| Weather products on ETMS | 2X per year |

| | |
|---|---|
| Weather and Traffic Database, Phase 1 | 9/03 |
| CCFP Requirements | 3/03 |
| CIWS Evaluation | 9/03 |
| AWTT Assessment of Weather Products | Annually |

**Smart Sheet:**
**Version 5.0, December 2002**

## EW-1: Integrate Weather Information into Traffic Flow Management

Improvements in the detection and forecasting of hazardous weather that adversely affects flight operations in the en-route domain are the first steps. But a change in operational practice requires an integration of weather information into decsion support systems and automated tools, as well as improvements in the communications and display of weather information, and the development of applications and training. ("Weather information" includes detection and forecast of hazardous weather as well as collecting current observations.)

### Background

Forecasts of hazardous weather have always been considered essential to maintain aviation safety. In addition, however, the existence of hazardous weather in a congested airspace can cause a severe reduction in capacity and efficiency of the NAS. In an effort to mitigate these reductions in capacity and maximize to use of the available airspace, a variety of tactics are used to evade hazardous weather, but these are difficult to evaluate because of 2 limitations:

1. A discrepancy between weather observations and the forecast skill (accuracy; precision, intensity, and reliability);
2. A deficiency in using weather information in Traffic Management strategies that mitigate the effects of hazardous weather in the en route environment.

Weather hazards are difficult to predict precisely and reliably because they depend on small scale processes that are not directly measured. Furthermore, hazards of icing and turbulence are often very localized and not uniformly distributed. In addition, the desired lead-time for prediction of thunderstorms covers several life-cycles of unstable overturning circulation imbedded in the atmosphere that sometimes includes a strong interaction with the surrounding flowstream.

The loss of capacity is even more difficult to manage because the required precision and lead time needed by strategic planning and national traffic flow decisions cannot be attained by weather forecasting. The uncertainty in the timing (as well as the location) of hazardous weather forecasts makes it difficult to identify the correct operational response in an air traffic environment where time is the most critical parameter. It is also difficult to create a smooth and efficient transition from strategic planning to a tactical response.

Plans for integrating weather information into TFM are based on the accomplishments of the past 3 years in which there has been a substantial investment in weather research and development. Many products and systems have been transferred into an operational environment:

-

- ADDS Aviation Digital Data Service on the Internet
- RTVS Real Time Verification System to verify convective forecasts
- CCFP Collaborative Convective Forecast Product to forecast thunderstorms 2/4/6 hours in advance
- NCWF National Convective Weather Forecast to identify and forecast thunderstorms on a national scale 1 hour in advance.
- ITWS Integrated Terminal Weather System to observe and forecast out to 1 hour in advance local thunderstorms using Doppler radar data.
- CIP Current Icing Potential identifies areas and altitudes of hazardous icing conditions.
- RUC Rapid Update Cycle weather forecast model now resolves winds and convection down to 20 km in the horizontal.
- Weather and Radar Processor displays NEXRAD data on the DSR controller screen based on a successful implementation at DFW.

The solution set for the EW Quadrant has also changed from "better data" to a single element that integrates priority weather objectives into a program leading to operational change: "Integrate Weather Informaiton into Traffic Flow Management". The foundation for these revisions are several important benchmark studies and the recommendations of advisory groups:

- An Aviation Weather Mission Need Statement (MNS) has been completed by ARQ-1 and approved by the Joint Science Counsel (JSC; 2002). Included in the MNS are 16 topics, of which the first priority is Thunderstorms; the second priority is Icing; next is Turbulence and Flight Level Winds.
- A Workshop of the National Research Council (NRC; June 2002) has addressed Weather Forecasting Accuracy for Traffic Flow Management. Although the assessment of the Workshop by a select committee of the NRC is not yet complete, there was encouragement to sustain the development and application of objective weather forecast models.
- The Second Workshop on Air Traffic Management and Decision Support Systems (July 2002) was sponsored by AUA-1 and MITRE, NCAR, and MIT/Lincoln Labs. The participants stressed the ultimate objective which is to integrate weather forecasts into automated traffic management tools in Decision Support Systems.
- The Aviation Weather Technology Transfer (AWTT) Board has developed a disciplined process for transferring research results into operational practice. The Board has developed standards for operational products and is leading the effort to encourage the early development of a Concept of Operations for each weather product.
- The Workgroups of Collaborative Decision Making (CDM) include participants from airlines, government and employee unions. The Workgroups are leading the implementation of changes to the traffic management system. Workgroups on weather, training, and integrated TFM are especially relevant.

### Ops Change Description

The first strategy for achieving the goal of EW-1 is blindingly simple: increase the skill of all forecasts of hazardous weather. Such a strategy would eliminate the weather discrepancy, and would provide a traffic flow management specialist increased confidence in their decisions to mitigate congestion. Unfortunately, forecast skill beyond a few hours is low, and the best technical evidence from the science community (NAS, 2002) is that improvement in forecast skill will be incremental. However, this approach is a direct attack on the problem and it must be sustained.

***First strategy: Increase the skill (accuracy, resolution, intensity, and reliability).***

In order to make operational changes, however, weather information must not only be “better”, it must also be used more effectively. The existing, uncertain operational weather forecasts can be used for air traffic decisions that will mitigate, but not eliminate adverse impacts on the NAS. This requires a description of the strengths and weaknesses of new weather products, and training on the use of weather information for traffic management. Included in this strategy is an integration of a spectrum of weather products to avoid overlap and confusion. Improving the training will require the development of “best practices” that are a result of operational experience, and a systematic, two-way feedback from the experience of mistakes and triumphs between users of weather forecasts and providers of weather information.

***Second Strategy: Mitigate impacts of weather on traffic in the NAS.***

Finally, in order to achieve the full benefits of operational change, reactions to redirecting flights must be understood before the decision is made. Note that although hazardous weather restricts airspace, the decisions of Traffic Management Specialists and Traffic Controllers may often concentrate traffic flows in other regions of the airspace which subsequently requires delay programs, flight restrictions, or ground stops. This circumstance is exacerbated by the uncertainty in the weather forecast and the sheer number of aircraft that need direction. In this environment, “better” weather information is insufficient by itself; it must be used in conjunction with traffic management tools to manage the consequences of traffic decisions that were first initiated in reaction to hazardous weather threats. This can best be done through the development of Decision Support System (DSSs) and automation tools that bring objective weather information into the decision. Thus, the ultimate payoff is contained in the third strategy.

***Third Strategy: Manage the reaction to traffic flow decisions***

Both improvements to the forecast of weather hazards, and improvements in the application of forecasts to traffic flow management are based on the priorities of the Mission Need Statement for Aviation Weather (ARU-1, 2002). The results from these priority engineering projects capitalize on state-of-the art empirical scientific investigations and research. For thunderstorms, the focus is forecasting of growth, decay, movement, intensity, and coverage. For icing and turbulence, the focus is the forecasting of intensity and coverage, especially in the vertical dimension, and its evolution in time.

However, since improvements in forecasts of hazardous weather can be expected to continue only incrementally; improved forecasting alone will not produce completely the desired results. How these improved products are disseminated, displayed, interpreted and applied (EW-1.2, 1.3) is just as important as improving the forecast itself (EW-1.4). Feedback to the producers of forecasts depends on a resident database of coincident weather and traffic data, and the ability to access these data and perform critical assessments in near-real-time. Operational change can be initiated with practical guidelines from experience that can be used to impact strategic planning and tactical decision making, based on reliable, shared situational awareness.

But the full potential of operational change cannot be achieved without Decision Support Systems (DSSs) and automated procedures that will accept and integrate weather and traffic information (EW-1.1) The DSSs are used to guide decisions that mitigate the impacts of hazardous weather, as well as to evaluate the consequences of possible traffic management options. This is the ultimate goal of the EW Quadrant, and the Solution Set (EW-1). The objective is shared with ER-2 (Collaborate to Manage Congestion), and it was part of the former EW-2 (that was moved to ER-2).

### The EW-1 Solution Set consists of the following structure:

**EW-1.1 Integrate Weather Forecasts into Decision Support Systems (DSSs)**
1.1.1 Route Availability Planning Tool (RAPT)
1.1.2 Enhanced Traffic Management Service (ETMS)

**EW-1.2 Commit to applications and training**
1.2.1 Applying the Weather Forecast
1.2.2 Training for Users

**EW-1.3: Ensure dissemination and display of weather information**
1.3.1 WARP PPI
1.3.2 Weather display on ETMS
1.3.3 Weather communication architecture
1.3.4 Weather Database
1.3.5 Post Analysis and Feedback

**EW-1.4: Improve the detection and forecast of hazardous weather**
1.4.1 Thunderstorms (Thunderstorm Impact Mitigation)
1.4.2 Turbulence (Non-Convective Turbulence and Winds Aloft Optimization)
1.4.3 Icing (In-Flight Icing )
1.4.4 Weather Forecast Models

Most of the elements of this Solution Set are already in existence. However, the objectives are independent and milestones have not been integrated into the EW-1. To take the next step and make the Solution Set productive, several Key Decisions must be made (below). The foremost decision is to identify a weather Focal Point who can mobilize the existing projects into an coherent program to meet the objectives of this Solution Set, EW-1. Subsequently, existing projects will be fully identified in an Integrated Project Plan that will be summarized in fully developed EW-1 Solution Set that will match the Key Activities of the EW Sector

### Benefit, Performance and Metrics

- Reduction in the variance of flight time as compared to the schedule.
- Reduction in number and/or duration of ground delay programs in support of SWAP for en-route hazardous weather constraints.
- Reduction in the number and/or duration of ground stops due to hazardous en-route weather constraints.
- Reduction in fuel diversions due to hazardous weather encountered.
- Increase the equity of the NAS. This equity is achieved from narrowing the confidence gap that exists today from one system user to another or one FAA facility to another. Metrics are system access; area throughput; increased user acceptance of the daily Strategic Plan of Operations and

equitable distribution of system resources.

## Key Decisions for the En Route Weather Program

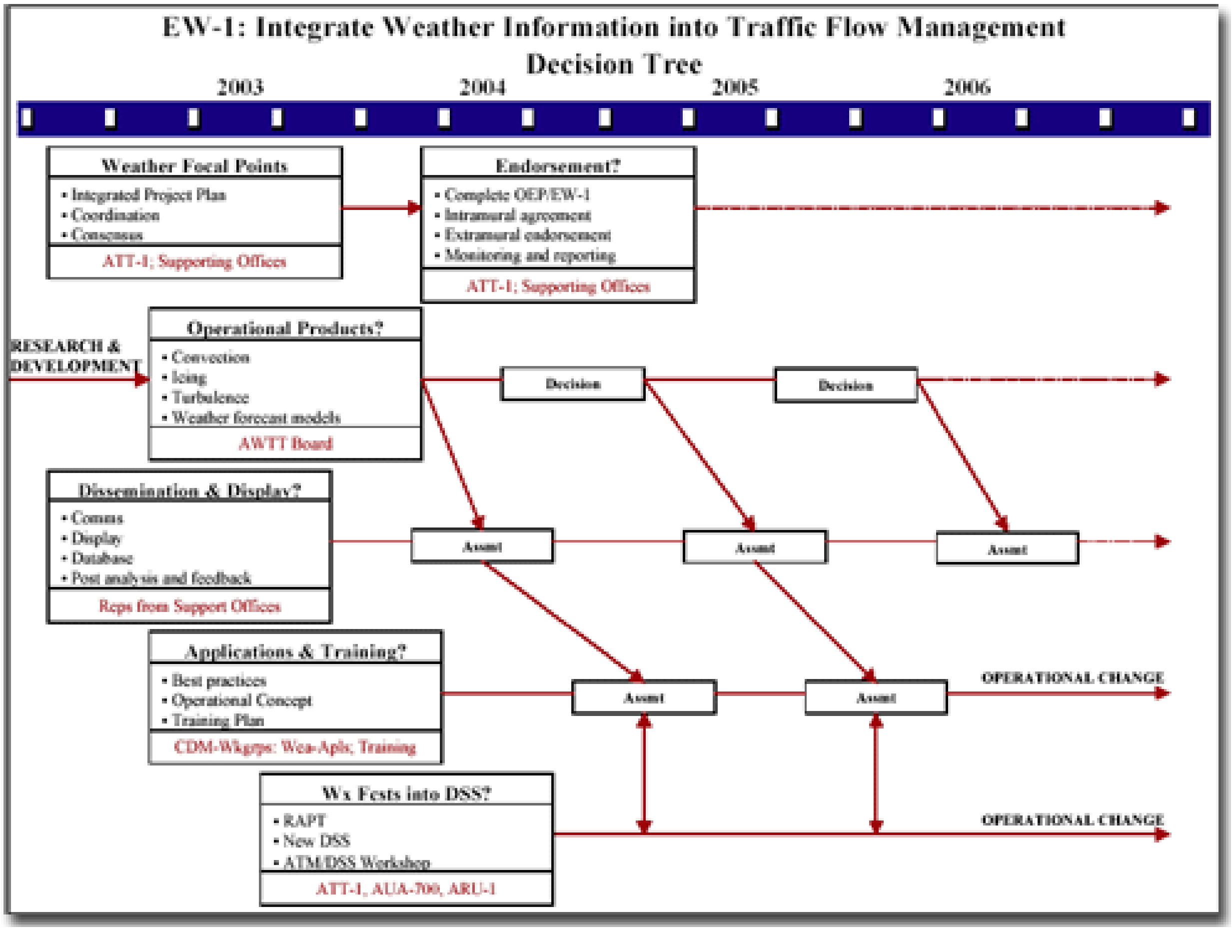
- Identify a Weather Focal Point and affirm the concept that will initiate and sponsor strategies to achieve operational change.
    - Coordinate and mobilize FAA weather offices to address the EW-1 structure and plan for operational change
    - Agree on projects, and designate project Leads
    - Write a integrated project development plan
- Transfer results from operations research into Decision Support Tools
    - Apply results from Lincoln Labs, MITRE, and NCAR, as presented in annual ATM and DSS Workshop (Jan 2003, and ongoing)
    - Development of a Concept of Use for weather in TFM
    - Apply results from the CDM-CR Workgroup on Weather Applications (WeaApls),(July 2003, and ongoing)
- Commit to institutional training and development of training materials for both passive (CBI) and active training of AT Controllers and TM Specialists.
    - Results from the CDM-CR Workgroup on Training (2003, and ongoing)
- Sustain funding for research and development of projects:
    - the Aviation Weather Research Program (AWRP). Project Review Teams (2002, and ongoing)
    - Development of a Aviation Weather Database of convective weather records with concurrent weather information and Air Traffic data archive (2003)
- Obtain support from constituents (NATCA, NWSEO, NAATS, ADF, ALPA, APA, ATA NBAA, RAA, SAMA) for affirming the objectives of Integration of Weather Information for Traffic Flow Management.
    - Meeting of CDM-CR Workgroup on WeaApls (Dec 2003, and ongoing)
    - Meeting of ATA Met Committee (April, October 2003)
    - Meeting of Friends/Partners of Aviation Weather (Oct 2003)

## Key Risks

- Coherence of an OEP program for Enroute Weather that brings diverse elements together for a common objective.
- Agreement on project-management roles for taking initiative, including responsibilities, coordination, accountability, and tracking progress.
- Agreement among all the extramural constituents and stake holders that are concerned with the use of weather information for managing en route traffic.
- Cooperation from the National Weather Service and the funding of improvements to contracted operational support.

## Decision Tree

- 




[View enlarged decision tree]

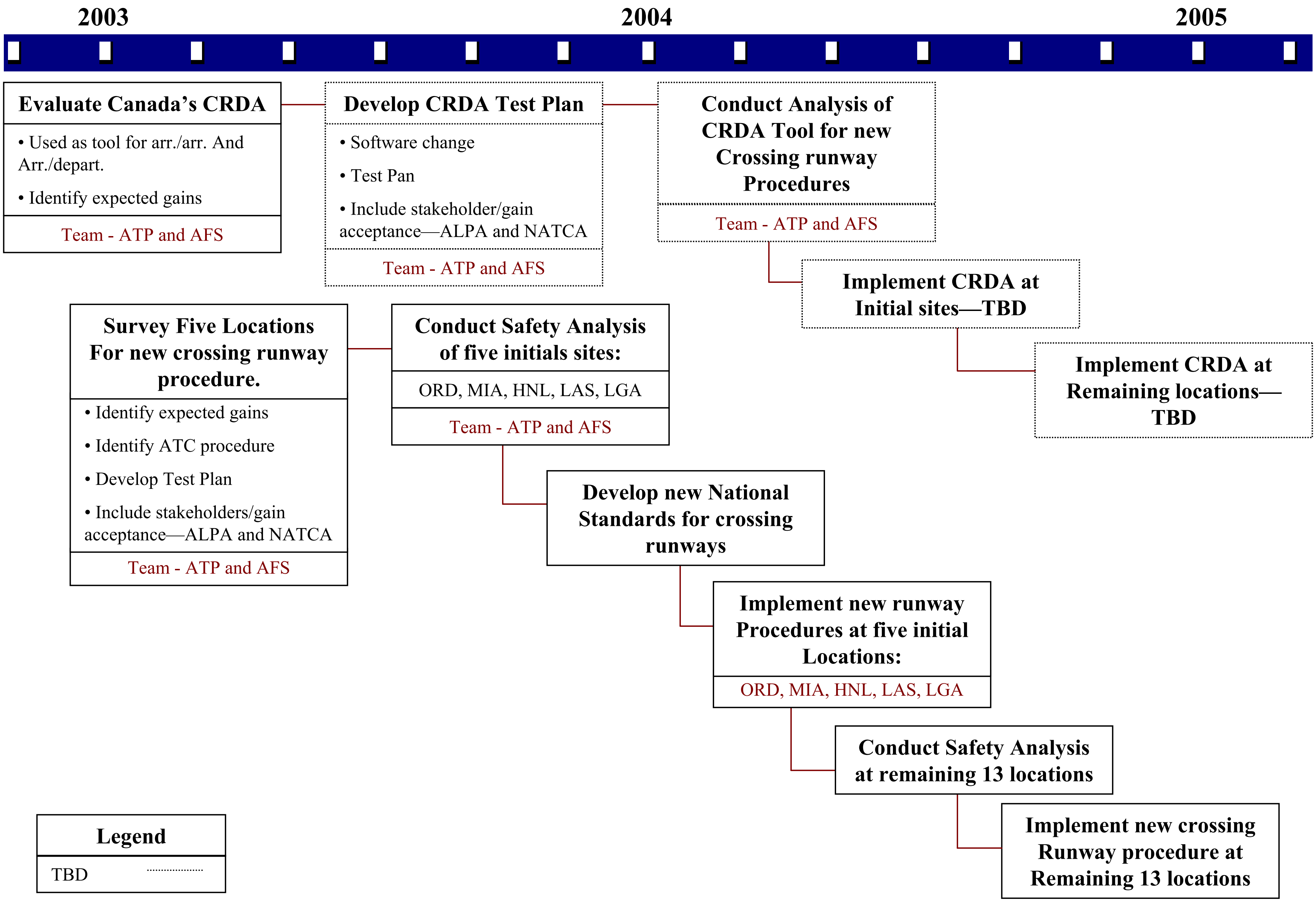
## Responsible Team

***Primary Office of Delivery***
Jack Kies, ATT-1

***Support Offices***
ATP-1
AUA-1
AUA-200
AOZ-1
AUA-400
AUA-700
ARU-1
ARS-1
ATA-1
AOZ-1
ASD-1

***Other Websites***
Relationship to the Architecture

# AD-2: Use Crossing Runway Procedure Decision Tree



# AD-3: Redesign Terminal Airspace and Routes Decision Tree

2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008

**Policy on RNAV**
OEP Team

**Analyze**
- Modeling
- Environmental (CatEx, FONSI)

Regional Team

**Implement**
- Training
- Charting & Automation Changes
- CLT, EWR, JFK, PHL, IAD, IAH, DTW

Regional Team

**Policy on Environmental Process**
OEP Team

**Characterize Site Problems**
- Operational Data
- User Input
- DEN, SLC, SEA

Regional Design Team

**Develop Design Concepts**
- LAADR/TAAP
- Single airport or multiple airport A/D routes
- RNAV Routes
- SCT, NCT, SBA, IAH, ATL, MCO CVG, CLE, CLT, HNL

Regional Design Team

**Analyze and Decide on Design Concept**
- Modeling to determine operational impacts
- Resectorization, as needed
- Environmental analysis and process
- NY/NJ/PHL, PCT, STL, SCT, NCT, SBA, IAH, ATL, MCO, CVG, CLE, CLT

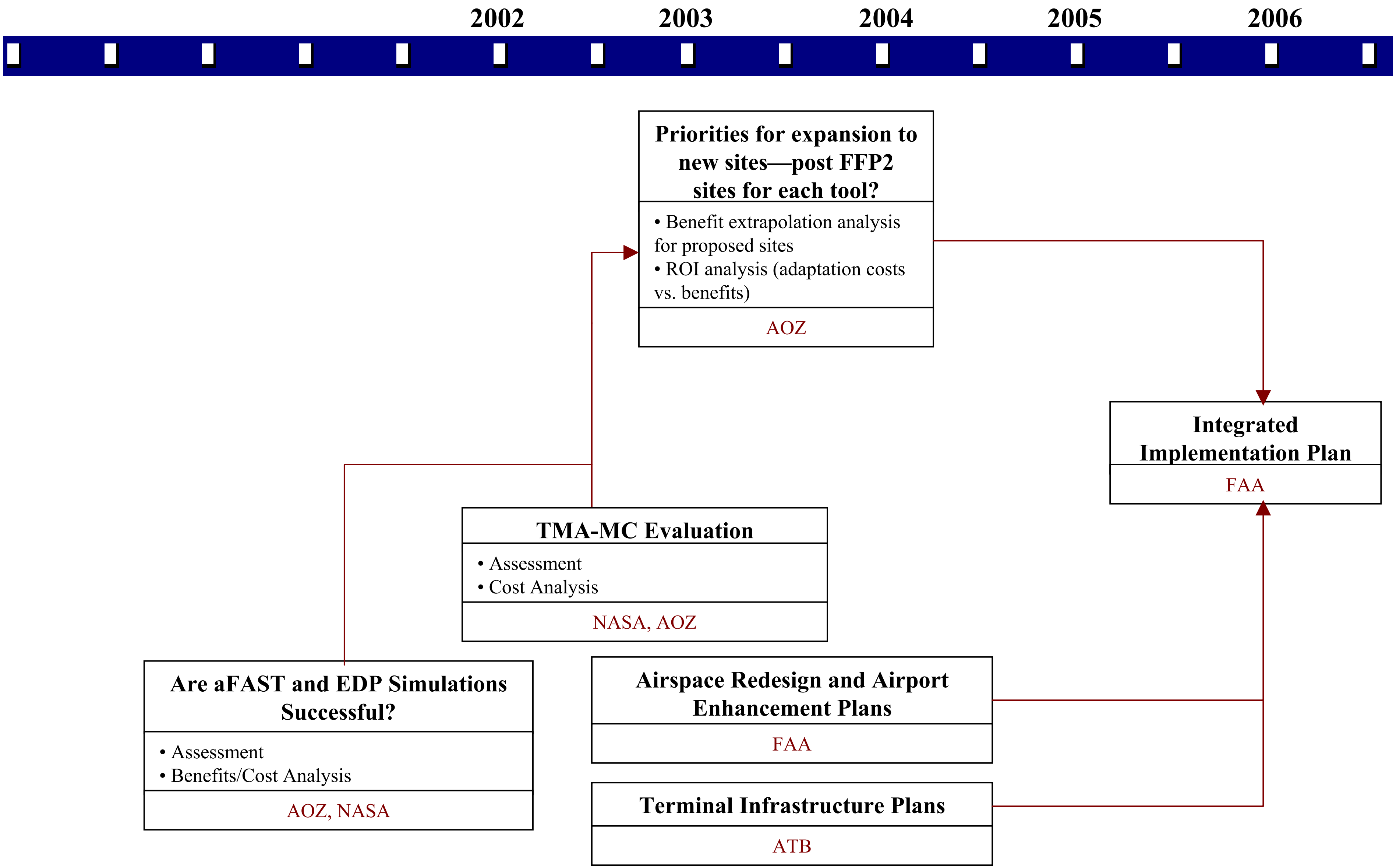
Regional Design Team
Regional AT Manager

**Implement**
- Training
- Charting & Automation Changes
- DTW, MSP, BDL, BOS, ORD, LAS, PHX

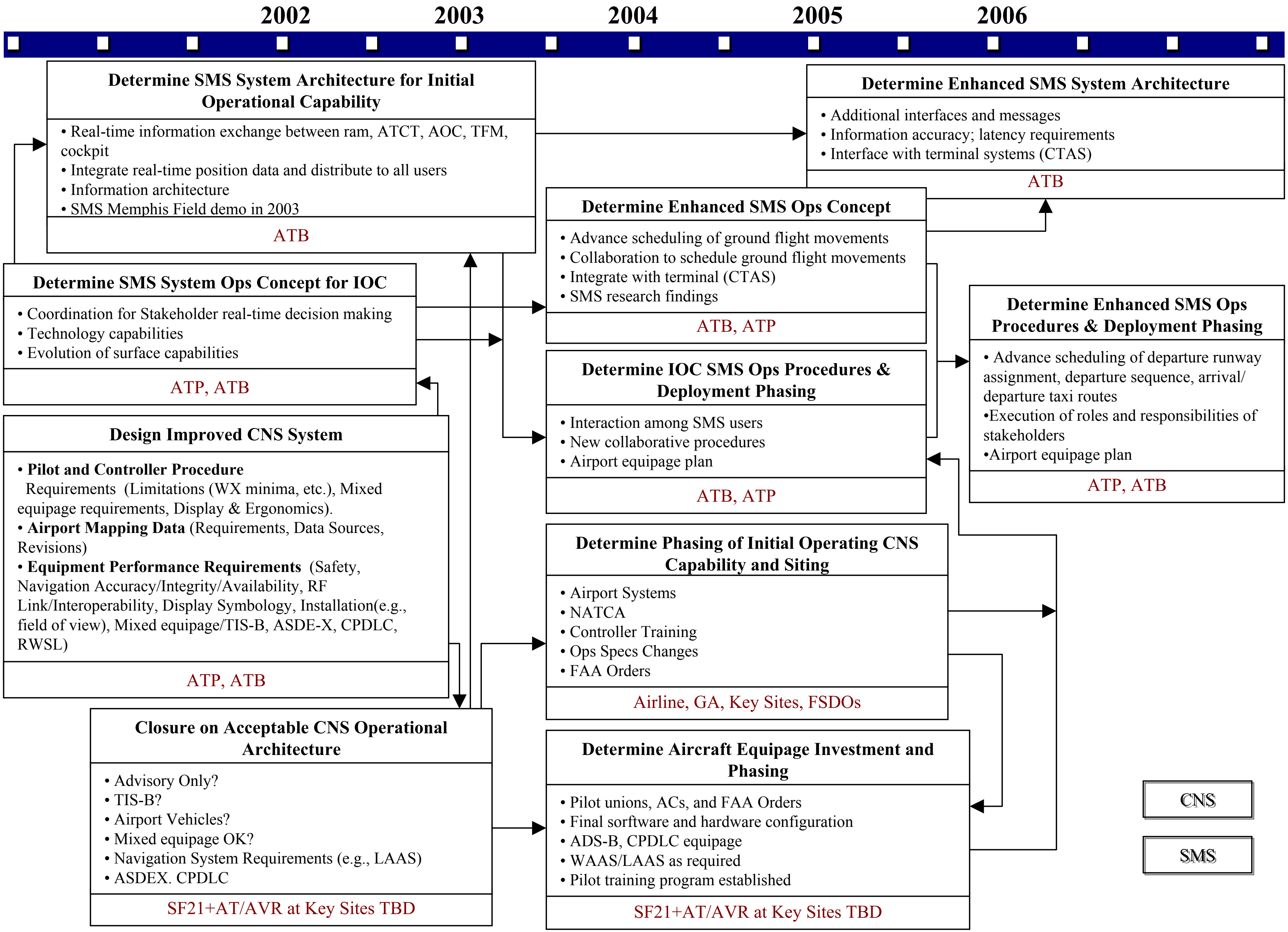
Regional Team

Time may be drastically reduced on length of environmental process

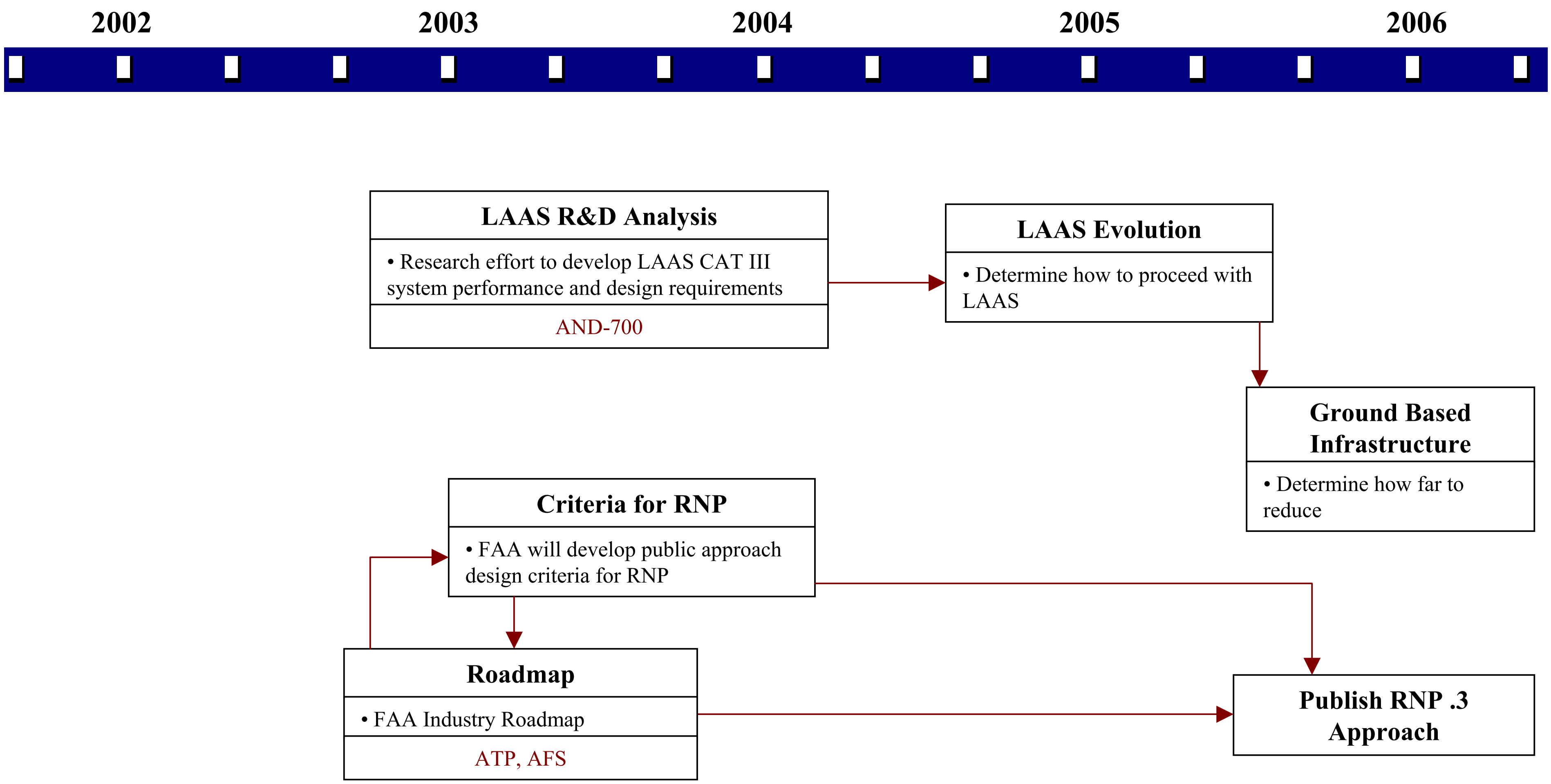
# AD-4: Fill Gaps in Arrival and Departure Streams Decision Tree



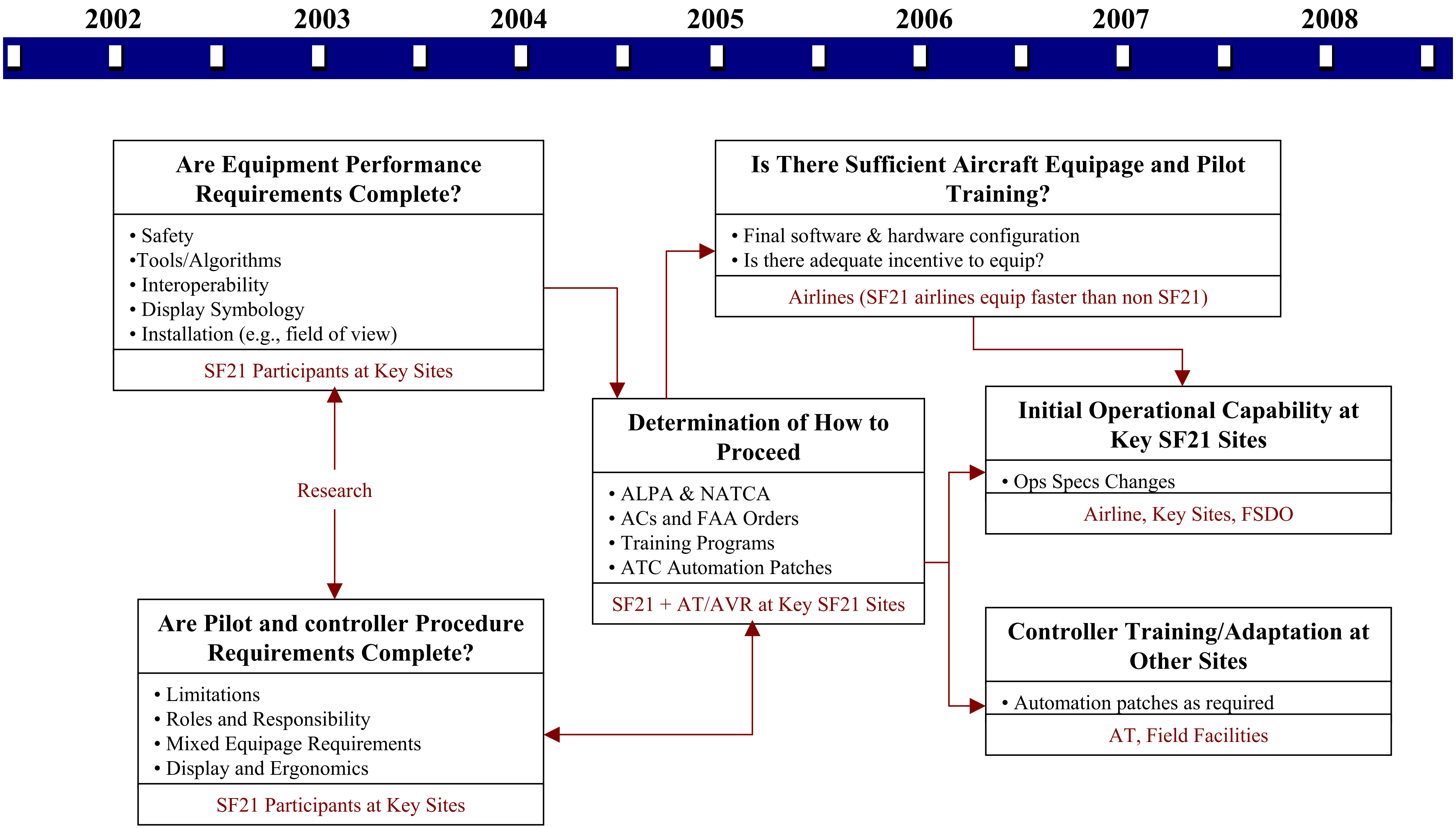
# AD-6: Coordinated for Efficient Surface Movement Decision Tree



# AW-1: Maintain Runway Use in Reduced Visibility Decision Tree



# AW-2: Space Closer to Visual Standards Decision Tree



# AW-3: High level Decision Tree for Reconfiguring Airports Efficiently

2003 2004 2005

**Evaluate Reconfiguration Procedures**

- Site by site evaluation, first 6 sites
- Determine if existing airport reconfiguration procedures are sufficient

ATP/Sites

**Procedure Modifications**

- Modifications of reconfiguration procedures (as necessary)

ATP/Sites

**Cost/Schedule Baseline**

- Decision on Revised Cost and Schedule Baseline

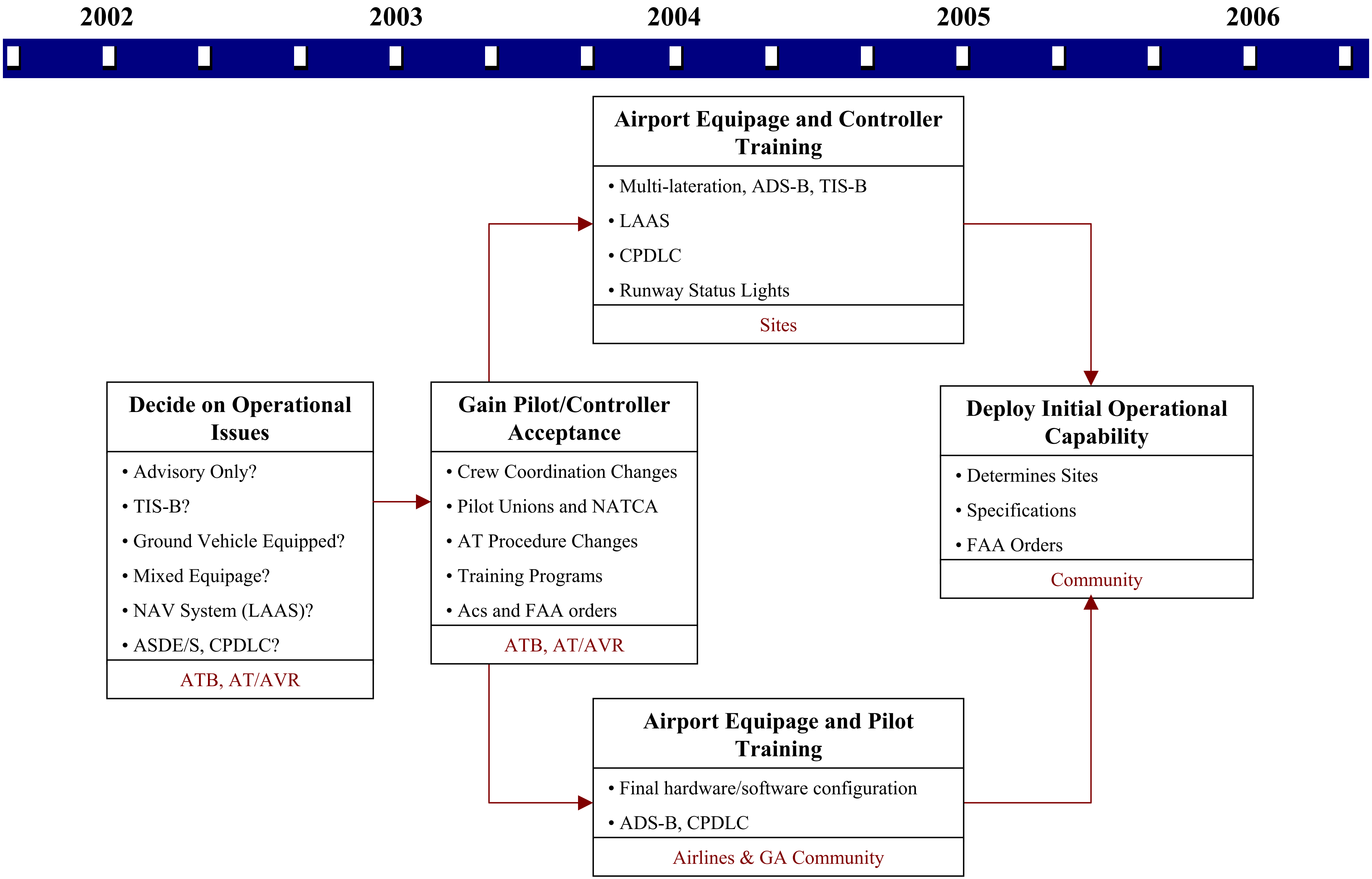
ATB/ATP

**New York Implementation**

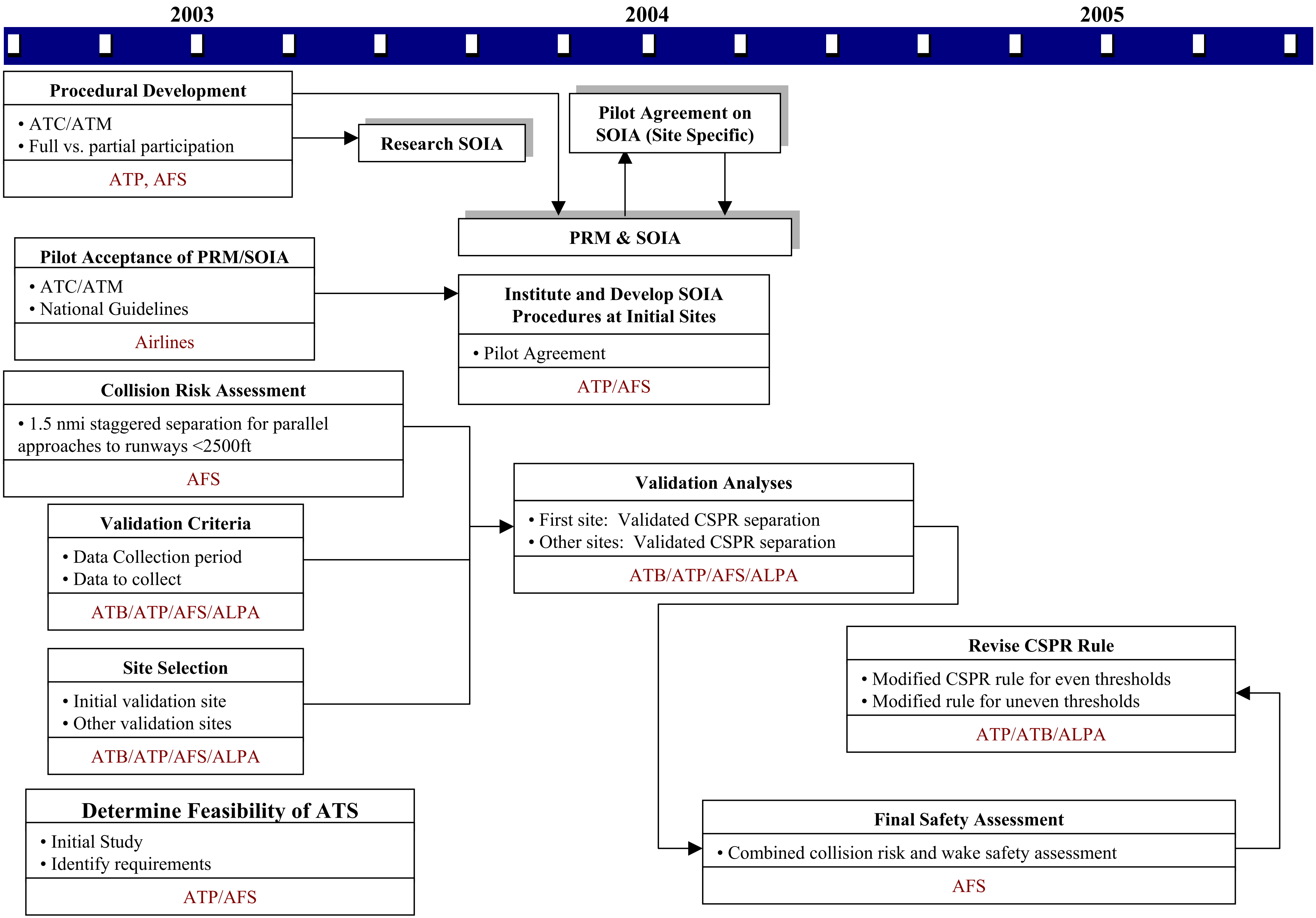
- Develop Playbook
- Develop communications of ITWS among TRACON, ARTCCC, ATCSCC, AOCs
- Facilitate common situational awareness and collaboration

ATB/ATP/ARTCC/TRACON/AOC/ATCSCC

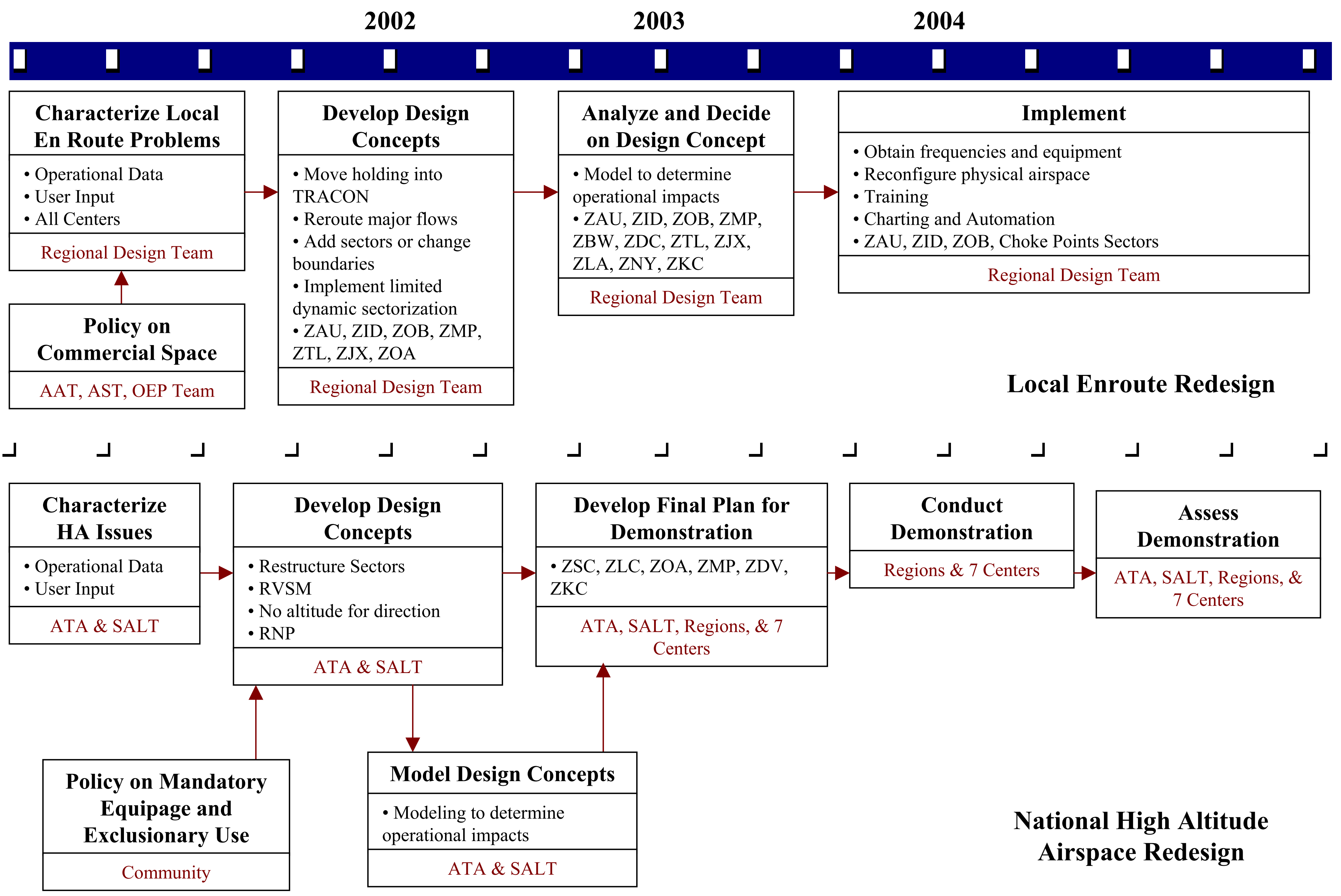
# AW-4: Enhanced All Weather Surfaces Operations Decision Tree



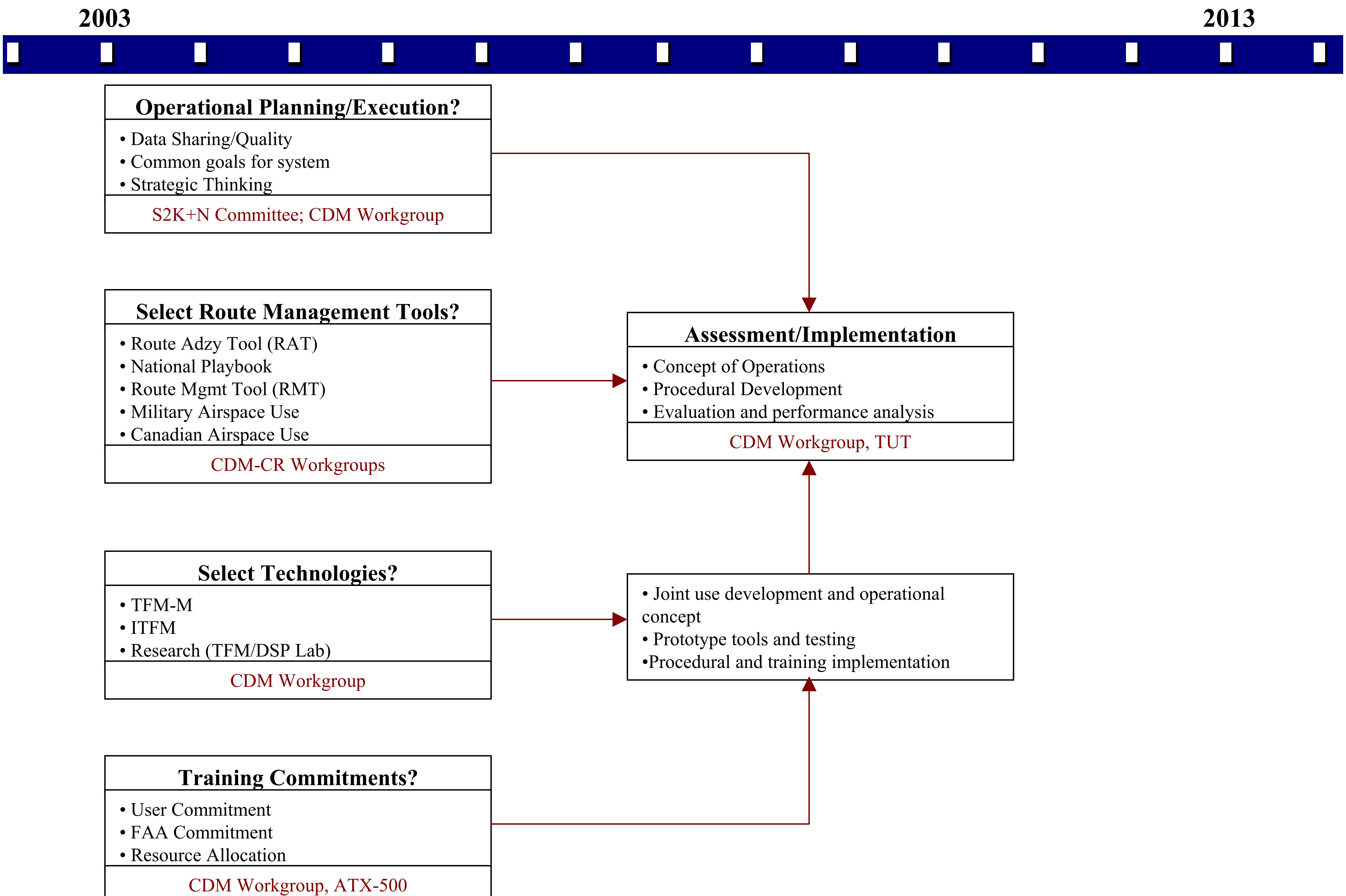
# AW-5: Maintain Optimum Runway Use at Airports with Closely Spaced Parallel Runways Decision Tree



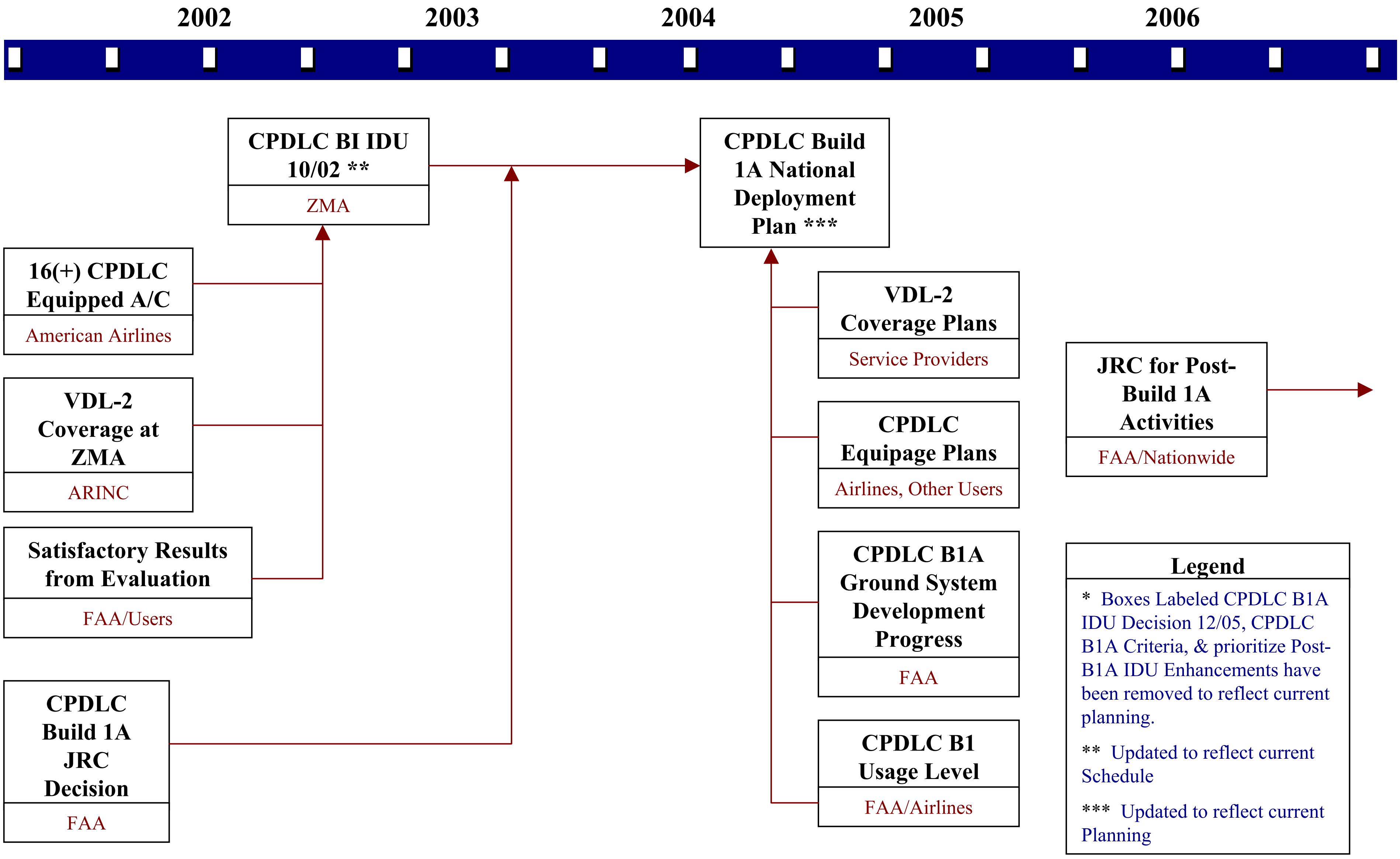
# ER-1: Match Airspace Design to Demands Decision Tree



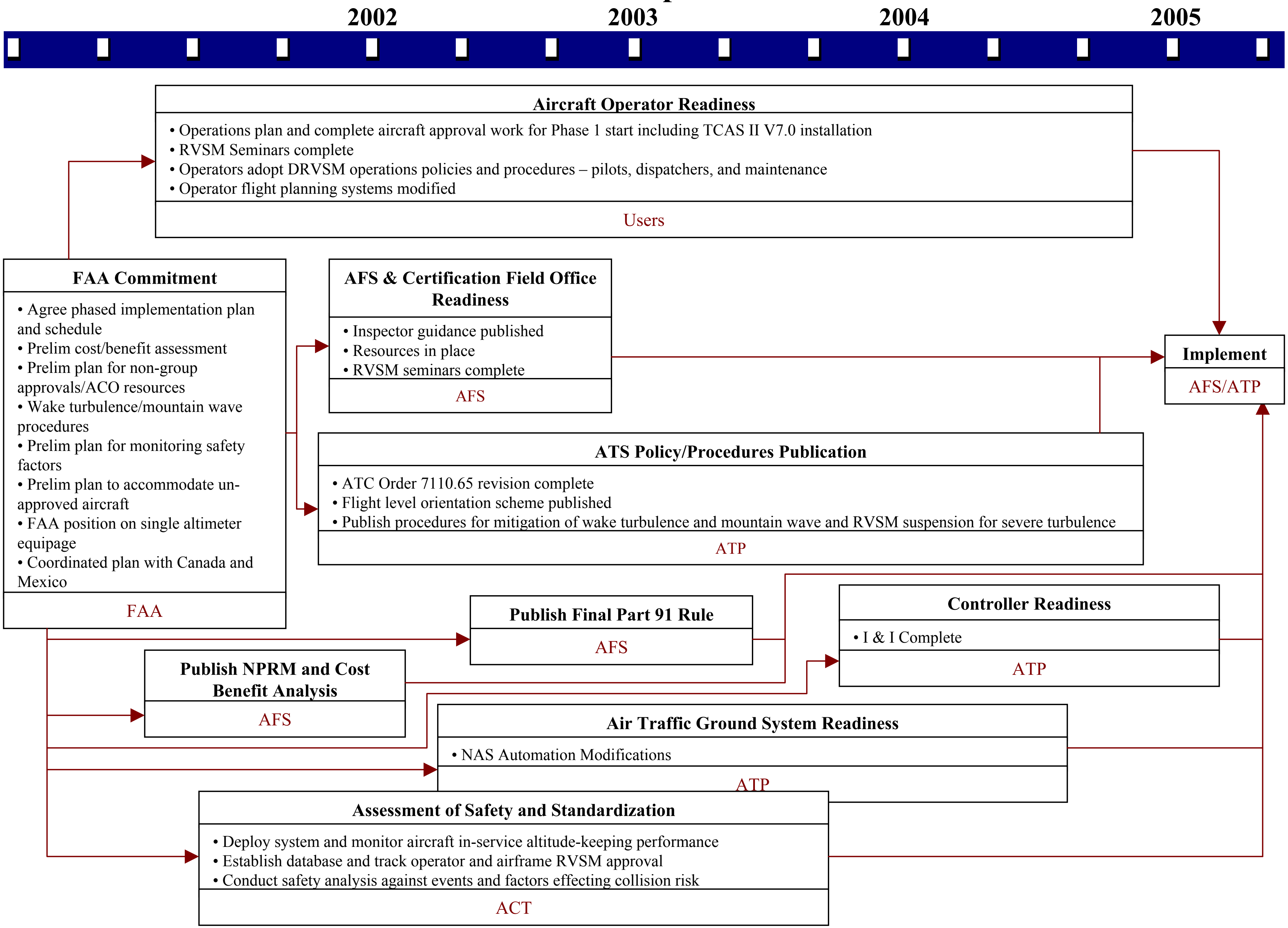
# ER-2: En Route Congestion Management Decision Tree



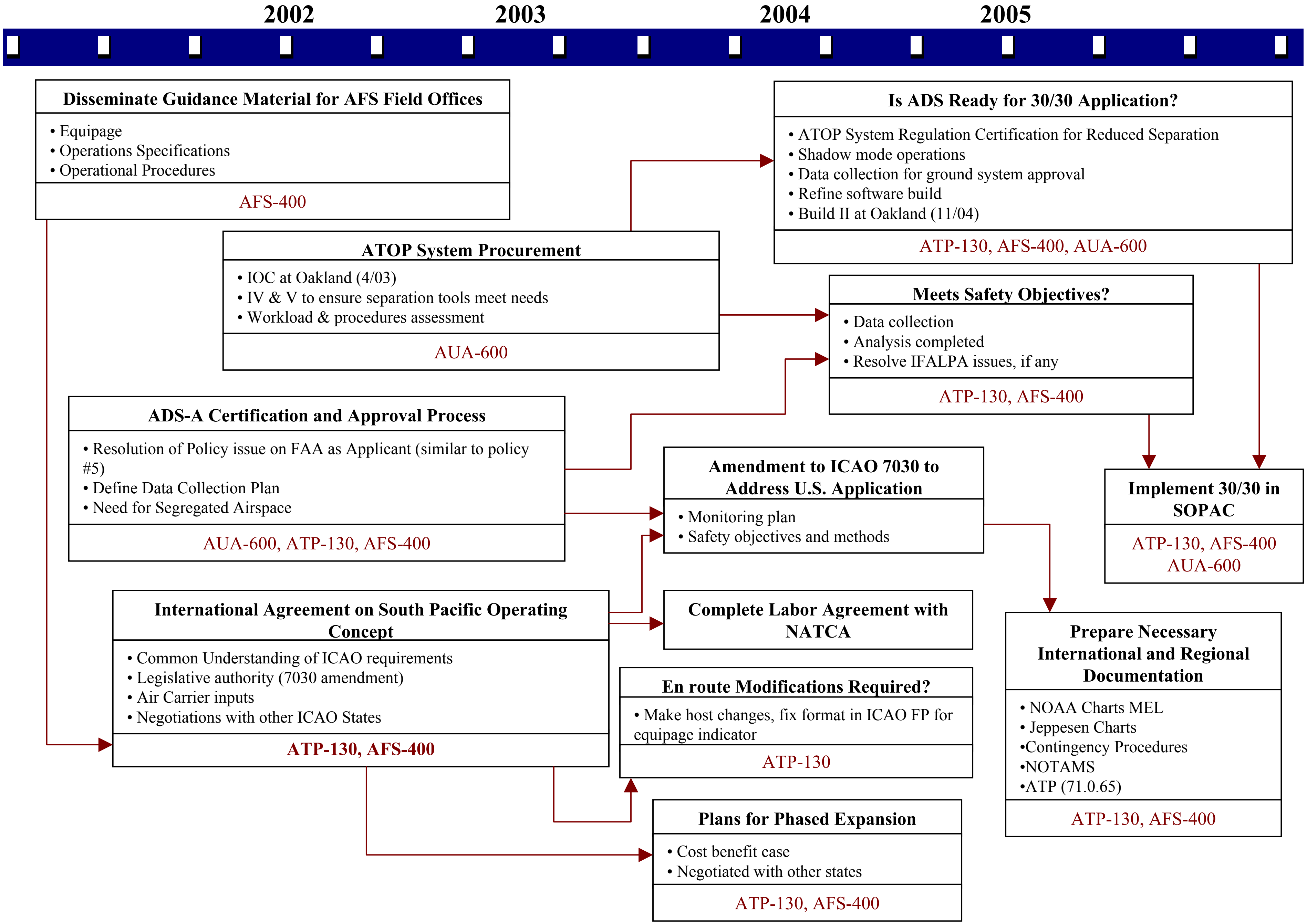
# ER-3: Reduce Voice Communication Decision Tree



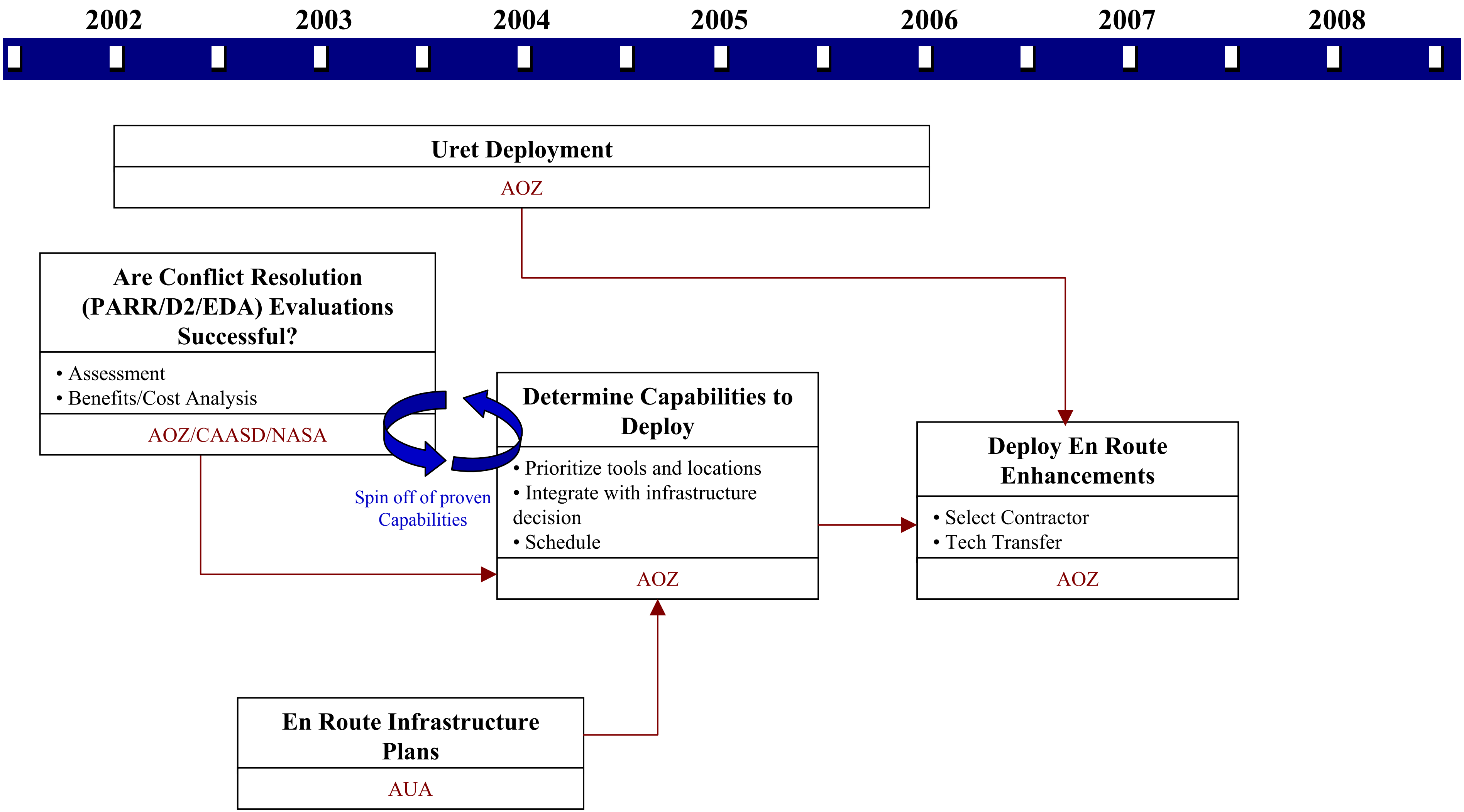
# ER-4: Reduce Vertical Separation Decision Tree



# ER-6: Reduce Oceanic Separation Decision Tree



# ER-7: Accommodate User Preferred Routing Decision Tree



# EW-1: Integrate Weather Information into Traffic Flow Management Decision Tree